

WHY

Our city can't
cope with
more frequent
cloudbursts

HOW

How do we keep
the city dry?

WHO

Who do we work
with?

WHAT

What are the
solutions?

Amsterdam Rainproof



Amsterdam
Rainproof

every drop counts





Preface

We are proud to present you with this publication, which celebrates the successes and achievements of Amsterdam Rainproof since its establishment four years ago. Along with its variety of public sector and private sector partners, this project is dedicated to creating a rainproof city. Rainproof collaborates with the municipality, the Water Authority, businesses and residents, housing associations, insurers, research and educational institutions, and professionals.

“Cloudbursts will become more frequent

Creating Amsterdam Rainproof represented a unique step for us. It was deliberately designed as a semi-independent programme outside the remit of our own organisations in order to build an egalitarian and broad network coalition. This is essential, as climate change will result in larger changes in precipitation patterns (characterised by more frequent and more severe downpours), and government authorities like ours cannot tackle these challenges alone.

For both the municipality of Amsterdam and the Regional Public Water Authority Amstel, Gooi and Vecht, this involves a change in approach, with the government stepping beyond its traditional role and actively connecting with other parties in order to share knowledge and solutions. This is an exhilarating and sometimes trying process, as any change in approach is bound to create some uncertainty.

We are therefore excited to further develop Amsterdam Rainproof, fully convinced as we are of its potential. We believe the programme is a testament to just how much more you can accomplish by sharing both problems and solutions and by looking beyond the boundaries of organisations and projects. This magazine sheds light on how the programme is organised and details the many rainproof measures which have been implemented across the city to date, ranging from green rooftops and rain barrels (see page 46) to rainproof neighbourhoods (see page 32) and fully water-neutral area development projects (see page 58).

Above all, the more than 40 interviews with stakeholders featured in this magazine demonstrate how you can take on these types of cross-organisational and multidisciplinary projects together. We hope these stories have the power to inspire other cities to follow suit. We must stop regarding rainwater as a problem, but rather see it as an opportunity to make our cities and towns more beautiful and sustainable, and thus improve the overall quality of life.

We are grateful for the opportunity to be able to work on improving our beautiful city together with our partners.

We hope you enjoy this magazine, and wish you lots of inspiration!

Udo Kock

Alderman for Water Issues, City of Amsterdam

Gerhard van den Top

Chairman of the board of the Regional Public Water Authority Amstel, Gooi and Vecht

Photo: John Gundlach — Photo cover: Getty Images / Hollandse Hoogte



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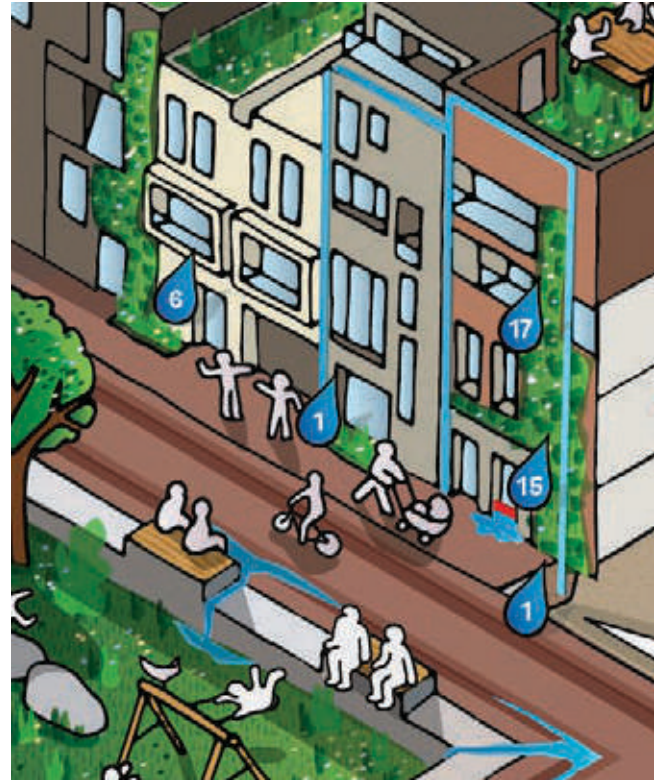
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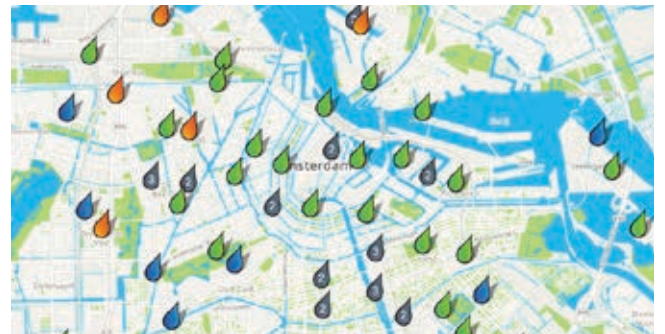
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WHY

Amsterdam Rainproof: sharing knowledge

Henk Ovink is a worldwide ambassador for the Dutch water approach. Amsterdam Rainproof is an inspiring example of how to effectively work together in climate adaptation and create positive change, he says.



If there is one country that knows how to adapt to water challenges it is the Netherlands. Positioned for a third below sea level and for two-thirds flood prone, we had no choice but to innovate. 'The Dutch culture of living with water is as old as the first settlers,' says water ambassador Henk Ovink. 'Organising ourselves around this challenge started around the twelfth century when the regional water authorities were the best collaborative answer to the water challenges: focused on securing safety and building quality. Water has always been an asset in the Netherlands; we've built our cities around it, designed our landscape and infrastructure accordingly and built our economy out of water. Even today two-thirds of inland shipping in Europe is in Dutch hands and Rotterdam is still Europe's biggest port.'

Water is an opportunity

The position did not exist yet, the Dutch government created it especially for him: since 2015 Henk Ovink is the first Special Envoy for International Water Affairs. As a water ambassador, he travels the world to help national and local governments; communities, businesses and international organisations deal with climate change and complex water challenges. How can we protect coastal areas from rising sea levels? How to maintain our drinking water supply clean and safe? And how to adapt cities to ever increasing precipitation and risks of flooding?



Photo: Suzanne Oudejans

“In the Netherlands, we see the water challenge not as a threat, but as an opportunity.”

‘The World Economic Forum named water-related crises as the biggest threat for this coming decade,’ says Ovink. ‘Ninety per cent of all disasters is water-related and in the next decades forty per cent of the world’s population is affected by too much or too little water. Two billion people drink polluted water and water crises impacts fifteen per cent of our GDP. We can’t waste these catastrophes, we must use them to fundamentally change,’ he says.

‘In the Netherlands, we see the water challenge not as a threat, but as an opportunity. We don’t wait and respond to past catastrophes, but anticipate, prepare and prevent them from happening, minimising their devastating impact. We have centuries of experience and capacity to share. In the Netherlands this is not about the government, it’s a collective effort. Everyone must come together, public and private, institutional and individual.’

Ovink advises governments on managing water risks and creating new opportunities. After hurricane Sandy in 2012, Ovink worked for the Obama administration and helped to rebuild the New York region better. In the White House, he was known as ‘Henk, the water guy’. He organised a design competition to collaboratively develop the best ideas: ‘If you want to be smart, you have to include everybody.’ His recent book, written with Jelte Boeijenga, *Too Big. Rebuild by Design: A Transformative Approach to Climate Change*, shows that the current challenges are too big to ignore and too big to solve alone.

Creating positive change

Other cities can learn from Amsterdam Rainproof, he says. ‘What is special about this program, is that it is cultural. Coming from within the city. It is collaborative by nature and connects the public and private sector, the individual and institutional world. Rainproof shows that it is not just the government that takes care of water, but that the Amsterdam Dutch are collectively caring for it. People in Amsterdam embrace it and believe in it: “we can do this”.’

With a pragmatic and hands-on approach, Amsterdam Rainproof is changing the city to better anticipate climate change. ‘Everyone embraces this challenge, and sees it as an opportunity,’ says Ovink. ‘Rainproof grows into a movement, something to learn from and celebrate.’

There are a lot of initiatives around the world campaigning for climate-proof or water-sensitive cities. But says Ovink: ‘What is unique about the Dutch way of working with water is that we think and work systemically. With a comprehensive approach knowing everything is ultimately connected to water. We see this complexity as strength, an opportunity. And because of this comprehensive, collaborative and innovative approach we can add value. This is also true for Amsterdam Rainproof: they combine climate adaptation with political, economic and social change. That is where the real added value comes from. Amsterdam Rainproof is one big connection machine, increasing impact wherever it goes.’ 💧

Amsterdam Rainproof Making the city rainproof together

Rainproof programme manager Daniel Goedbloed, managing director Waternet Roelof Kruise and Waternet strategist Maarten Claassen.

Amsterdam Rainproof is preparing the city for extreme cloudbursts. As this problem affects everyone, all 'Amsterdammers' are involved in the solution.

When the city of Copenhagen was hit by a cloudburst in July 2011, it received 150 millimetres of rain in just an hour and a half (the average equivalent of two months of rainfall in the city). The concentrated downpour caused a staggering one billion euros in damage. 'It was a real wake-up call for us: what would happen if our city were struck by that kind of torrential weather? Would it grind public life to a halt and cause untold damage?' asks Roelof Kruise, managing director of Waternet, Amsterdam's water company.

A simulation instantly showed that Amsterdam was equally vulnerable to extreme weather, with some areas showing a 45-per cent likelihood of damage during heavy rainfall. How to prevent this? The initial inclination may be to expand the sewers. However, that would be ineffective, extremely expensive and the construction work would be very disruptive. It would also mean missing out on opportunities to make the city more resilient, greener and more attractive. This is why Waternet launched the 'Amsterdam Rainproof' project on 1 January 2014, with the objective of creating a rainproof city by 2050.



“This problem affects the entire city. It’s impossible for any one party to resolve it alone

Photo: Michael Barnett Boesen/Polifoto

The 2011 cloudburst in Copenhagen was a wake-up call for Waternet.

Broad partnership

‘To become truly rainproof, you need to improve the “sponge effect” of the city. That includes the sewer system but especially includes the public and private spaces such as streets, gardens and rooftops,’ says Rainproof programme manager Daniel Goedbloed.

That means working together. Rainproof has been tasked with involving all stakeholders in the rainproof city: this includes the Water Authority and the municipality, along with businesses, property owners, residents, consultants, and research and educational institutions. Using the motto ‘Every drop counts’, the Rainproof programme seeks to make people aware that they are the co-owners of both the problem and its solutions. Instead of adopting a moralising tone, the programme invites the community to ‘together make the city rainproof, greener, more liveable and more beautiful’.

Crossing boundaries

‘This problem affects the entire city. It’s impossible for any one party to resolve it,’ says Maarten Claassen, a strategist at Waternet and one of the founders of the Rainproof programme. Waternet had previously experimented with a network-based approach in several rainproof pilot projects in Amsterdam’s Watergraafsmeer district. Claassen explains that this partnership, involving a variety of players, turned out to be a success: ‘It makes all the difference to have the support of your partners when addressing some of the problems facing the city. You can simply get more done together.’

The time had come to expand this approach across the rest of the city, but this turned out to be far from easy, with so many organisations used to working in their own separate

silos. Roelof Kruise: ‘We’re still up against a lot of rules that prevent change. The idea, really, is for all of Waternet to adopt rainproof methods and procedures. Rather than being confined to our own silo, we’re looking to connect with others by using a network-based approach.’

Focus on extreme rainfall

On the Rainproof platform many different individuals and organisations share their knowhow and expertise and are able to ask questions. As Goedbloed explains, the focus on rainwater is a deliberate one: ‘We avoid using terms such as “climate change” and “climate adaptation,” as these are big, abstract concepts. The average Amsterdammer wouldn’t know how to contribute to solving such problems.’ Roelof Kruise adds: ‘The point we’re trying to get across is that extreme rainfall is becoming more prevalent and that the city is not equipped to handle it. Since rainwater is visible to all of us, that’s something that anyone can wrap their head around.’

Amsterdam Rainproof set up its own multidisciplinary team, and, with its own website and logo, the programme has established itself as a standalone ‘brand’. Roelof Kruise: ‘We didn’t want to market it as a government programme as such. When it comes to water-related issues, people tend to think it’s the government’s responsibility, but that is not the message Rainproof is trying to spread.’ This approach has also allowed the team to operate with greater freedom, and to develop their own flexible methods, working around the traditional government approach, constantly taking advantage of arising opportunities.

The Rainproof approach was further developed over a four-year period. The network currently includes some eighty partners, ranging from engineers to garden centres and from government authorities to ‘citymakers’. This magazine celebrates the accomplishments they have made together with Rainproof. 💧

Insurers share information on water-damage claims

Sharing and analysing data on rainwater damage leads to more insight and can prevent future damage. Insurance companies are vital in this process.

In a recently published report titled *Hoofd boven water* ('Head above Water'), several Dutch insurance companies warn that, unless measures are implemented to counter the effects of climate change, the total amount in insurance claims for buildings and cars could rise by up to one quarter billion euros. The report cites rain as the main culprit, currently accounting for a total of 188 million euros in insured damage to homes and industrial premises. With this amount potentially set to increase by 88 million over time, now is truly the time to take action.

“Special that municipality and insurance companies share data with each other.”

Data analysis

The severe downpour that hit the Amsterdam area on 28 July 2014 produced some significant data. Waternet, the Amsterdam fire brigade and insurance company Achmea combined the claims and information they received from the public during and following the downpour and had this data analysed by researchers at consultancy firm Synoscope and Delft University of Technology (who also interviewed residents affected by the downpour).

A large amount of the damage is the result of roof leaks caused by blocked or broken gutters. However, the most vulnerable homes are those located on the ground floor or with basements. The researchers found that water damage caused to basements is, on average, twice as large as run-of-the-mill water damage. They also learned that sixty-five per cent of people who sustain water damage do not file claims, which indicates that the actual damage is significantly higher than that recorded by insurers.

Leading the way for the rest of the country

'It was special to see the municipality and insurance companies share data with each other,' says Timo Brinkman of the Dutch Association of Insurers. This specific partnership falls within the remit of the national Delta Plan on Spatial Adaptation. The goal of the collaboration is to make the government and insurance companies reduce and prevent damage and loss. Brinkman: 'I would like to see this project gain traction nationwide.'

Rainproof and the Insurers' Association are advocating for increased cooperation in preventing damage and loss and creating awareness. Leading Dutch insurer Achmea provides tailor-made advice and publishes an online magazine filled with rainproof tips.

Timo Brinkman is thinking even further ahead, proposing the introduction of a rainproof certification, similar to the certifications awarded by the Dutch police to homeowners as proof of a safe and secure home.

WHO

Businesses build a dry Zuidas



Eline Kik (Green Business Club Zuidas), Marjolijn Smit (Vesteda) and Maarten van Casteren (municipality of Amsterdam) on a green-blue rooftop at De Boelelaan.

Amsterdam's Zuidas business district is one of the areas with the highest concentrations of concrete in the city, making it vulnerable during bouts of heavy rainfall. For the business community, climate adaptation offers a solid business case.

The Zuidas district is one of the most in-demand construction sites in the Netherlands: a high-density area that continues to attract new office buildings and homes. Flooding in the lower-lying parts caused by heavy showers will inevitably result in financial losses.

'If we build more, we also need more room for water,' says Maarten van Casteren, a project manager for the municipality of Amsterdam, whose portfolio of responsibilities includes sustainability, water and greenery. This used to mean perhaps adding an extra ditch by way of watercompensation. 'Rainwater was an obligation. Now we simply like to focus on the opportunities.'

Take, for example, the subterranean water storage facility beneath Gustav Mahlerplein, which transports up to 750,000 litres of rainwater to the canal. Or a green urban infiltration strip as part of a new housing development. Its purpose is to detain water and 'slow it down' before it enters the sewer system. The strip captures excess stormwater runoff from the street and buildings. But are private companies also committing to climate adaptation? →



The polder roof at Vivaldistraat: popular for lunch, meetings and a breath of fresh air.



The green urban infiltration strip at Zuidelijke Wandelweg.

Water-neutral development brief

Peak downpours do not only fall on public space, but also on private terrain. Since capturing rain on the spot is the most effective stormwater management method, property owners should cooperate. They benefit directly from clear regulations. “Rainproofness” is therefore one of the conditions of the development brief for new area development in the Zuidas business district. Specifically, a plot of land must be able to capture a minimum of 60 millilitres of rainwater on-site and discharge it slowly within a period of 24 hours.

Green-blue rooftops provide a solution for existing and new buildings: these water-retention roofs or polder roofs (see also p. 46) can capture and retain rainwater. While this may require investments, the returns are high: a roof garden improves biodiversity, indoor climate, air purification and building quality, as well as enhancing the building by adding an appealing outdoor space.

As an added bonus, property developers earn BREEAM points (BREEAM is an assessment and certification scheme for sustainable buildings).

Existing buildings

The municipality of Amsterdam and the regional public water authority Amstel, Gooi and Vecht are working closely with businesses affiliated with the Zuidas Green Business Club, a network organisation founded six years ago in efforts to improve the area’s sustainability.

“Two key objectives are “rainproofness” and “more green spaces,”” says Eline Kik, programme director of the Zuidas Green Business Club. Their goal is to facilitate the construction of 25,000-square-metre water-retaining roof parks by 2020. Thirty percent of this target was met in 2017.

“The greatest challenge lies in the existing buildings,” states Kik. Together with the municipality, the Water Authority and the team of experts at Rooftop Revolution she contacts Zuidas businesses and property owners. Their message: climate adaptation offers an interesting business case, and improves sustainability. A green roof prevents flood damage, but also increases the value of the property.



Rainwater is retained on the green-blue rooftop at De Boelelaan.

“Thanks to the roof garden, rents are up slightly and the homes are in high demand

Solid business case

Home rental service Vesteda commissioned the construction of a green polder roof on top of a renovated housing complex on De Boelelaan. ‘To prevent rainwater damage and as a token to the residents,’ says Marjolijn Smit, technical manager for new development and renovation.

The roof consists of 450 square metres of green space and a 250-square-metre roof garden, and is built on top of a crate structure and substrate layer. Rainwater is retained on top of the roof. The vegetation attracts birds and insects, and makes the roof garden appealing year-round. Smit: ‘Residents are making the most of the rooftop. Although they all have their own balconies, they like to meet in the roof garden.’

Vesteda was keen to invest in its construction. ‘As part of the overall renovation of the building, we felt it presented a solid business case,’ Smit says. Completed just a year ago, the garden requires little additional maintenance at this stage, and in fact has already paid off: ‘Thanks to the roof garden, rents are up slightly and the homes are in high demand,’ Smit says. Vesteda is also investigating whether it is possible to install *polder* roofs on other buildings.

Added value to property

Property development company Breevast is also installing a *polder* roof on its own building on Vivaldistraat. In addition to investing a substantial amount of its own funds, Breevast received funding from the municipality for the construction of green rooftops, for which Waternet provided technical support.

‘Our view was a 2,100-square-metre gravel roof, and we were looking to turn it into something more visually appealing and sustainable,’ says Breevast project manager Judith Wintraecken. They knew for certain they wanted a green roof with rainwater-storage capacity. ‘We were, of course, aware of the pluvial flooding in this area.’ De Dakdokters (‘The Roof Doctors’), a firm specialising in rooftop transformation, put Breevast in touch with the Zuidas Green Business Club and Amsterdam Rainproof.


The result was a *polder* roof system and a roof-garden design with bamboo, weathering steel and concrete paths. The design team were inspired by New York City’s celebrated High Line Park, which is built along a disused railway line. The Breevast *polder* roof became a popular lunchtime spot, as well as a place to hold meetings or for local office workers to get some fresh air. Wintraecken: ‘We feel it adds value to our property; the tenants love it. But above all, it’s an important step towards greater sustainability.’ 



Photo: Amsterdam Rainproof



Photo: Waternet



The network strategy every drop counts

Considering that rain falls everywhere
– on streets, squares and rooftops –
making the city rainproof is a process that
involves everyone. But what, exactly, does
this process entail?

Amsterdam Rainproof uses a network strategy to connect and activate all parties that can contribute to creating a rainproof city. As the initiator of this network, Rainproof shares knowledge and information, refers and connects people, and initiates and supports projects. Four years since it was established, the network has around 80 official partners who endorse Rainproof's objective, along with numerous unofficial partners.

Stakeholder analysis

Whose cooperation is needed to make the city rainproof? Rainproof conducted a stakeholder analysis which identified twelve stakeholder categories: residents, community initiatives, property owners, homeowners' associations, housing corporations, civil servants, directors, insurers, research and educational institutions, business owners, media companies and NGOs. What drives these people, how can they contribute, and how might you be able to support them?

The main stakeholders come first, with the municipality of Amsterdam and Waternet topping the list. They make the decisions related to organising and rearranging public space, above and below ground. Furthermore, if the government sets clear parameters, it will be easier for other parties to join the initiative, as the housing corporations are doing now.

Rainproof analysed who determines the design of public space, who makes the decisions and on what basis, and who is in charge of implementation within the municipality. This

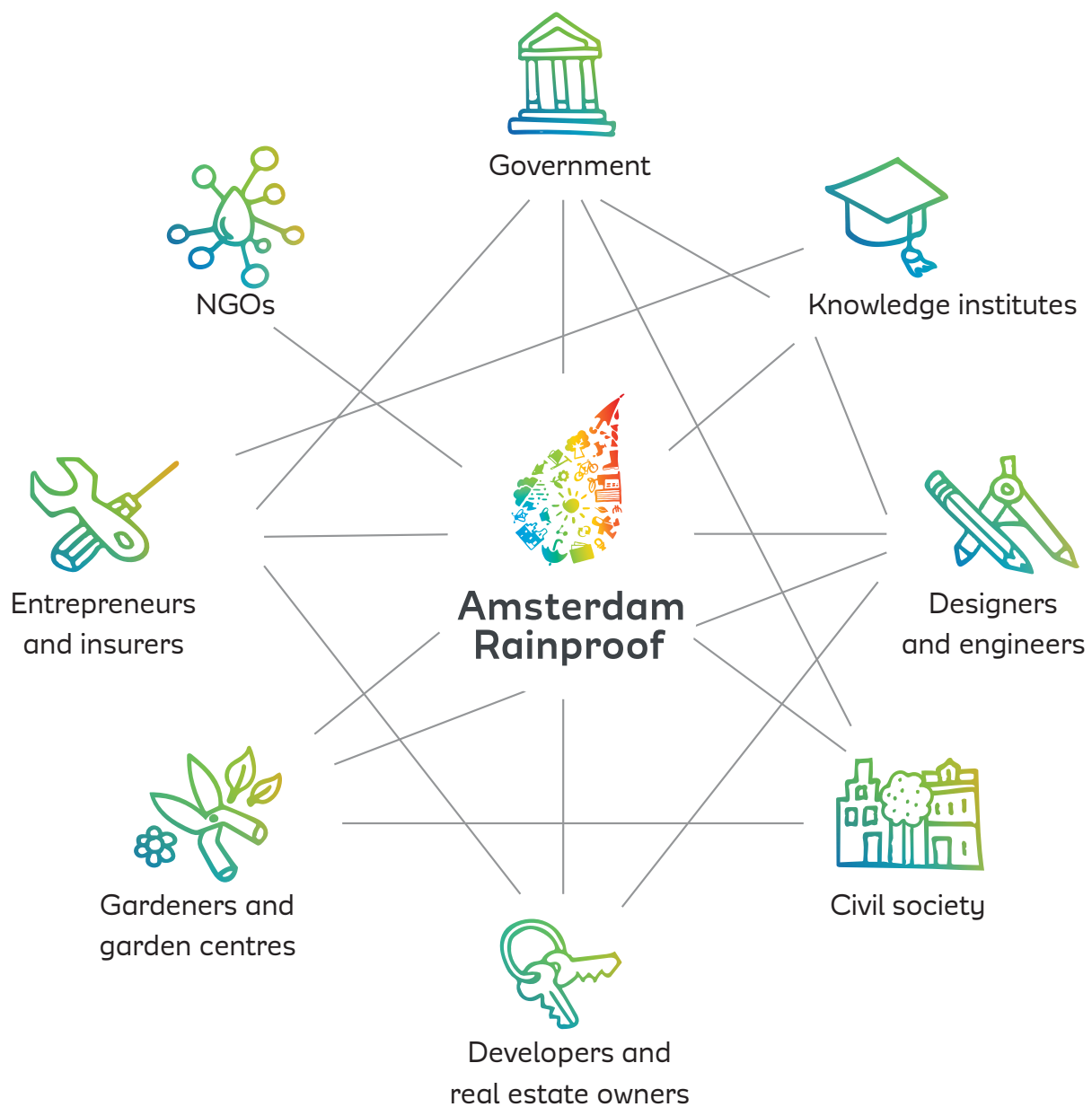
resulted in a list of hundreds of people, ranging from politicians to planners and from designers to contractors. Since it's impossible to contact all of these parties individually, the key is to find people who are open-minded and can think outside the box. If they manage to inspire their colleagues and get them to join the Rainproof initiative, this will be infinitely more effective than having an outsider do the job.

Finding a middleman

Private parties such as insurers, landscapers, garden centres, housing corporations and networking organisations act as middlemen and can be used structurally to reach larger groups, particularly homeowners. They can spread the message and encourage rainproof activities on private terrain. Rainproof sets out to find and support these middlemen: in some cases by sharing knowledge and in other cases by developing products and leaflets and by providing them a platform.

Industry associations or umbrella organisations can bring you into contact with these middlemen. Industry association VHG, for example, connected Rainproof with local landscapers. The Amsterdam federation for housing corporations is another example of such an umbrella organisation. For insurers, the strategy was to first start working with an individual insurer that was amenable to the idea. In the case of networking organisations and resident initiatives, Rainproof explored ways in which it could join existing initiatives. The approach and terminology used and the objectives tend to vary depending on the industry.

“Networks are dynamic and in constant flux – you cross paths with new people all the time who can help to make the city rainproof.”



Bear in mind that becoming rainproof is often only part of the objective for partners. While rainproofing might be at the top of Rainproof's list of priorities, this tends not to be the case with insurers, housing corporations, landscapers and residents. You should therefore try to find overlapping themes and shared interests. Housing corporations and insurers, for example, have an interest in reducing damage and loss, while product suppliers are looking to sell products while struggling at the same time with the fact that people don't recognise the problem as such. Project developers don't just want a sustainable building, but also an attractive or marketable floor space. The key to putting rainproof on the agenda is to find shared interests and highlight the opportunities involved.

Maintaining the network

So the network is in place – now what? The next step is maintenance: a network is in constant flux. You cross paths with new people all the time who can help you make the city rainproof, while at the same time you should be careful not to neglect your existing contacts. You should therefore make sure you are visible and continue to attend relevant meetings, conventions and events organised by partners. You should be accessible, keep the lines of communication open, and keep asking the members of your network what works well and what needs improvement. What are some of the barriers holding people back? How can we help them and refer them to the appropriate people?

A smooth-running network has access to valuable information and can essentially connect people as required. You can also maintain a network by keeping them informed. The Rainproof website is regularly updated and includes a newsletter and contact form. You should always answer all questions or forward them to the appropriate individuals. Take advantage of social media to share your personal news, celebrate successes together and share partners' information.

The latter is important: you maintain a network also by providing a stage for your network partners and allowing them to spread the message themselves. The network approach is ultimately not about Rainproof, but about the members of the network: they need to find each other and be able to take action. Rainproof just supports them. 🌱

WOW Award 2017 for 'Best Partnership'

Rainproof's network strategy has received its share of attention, even having won the WOW Award 2017. WOW is a Dutch government platform to promote cooperation between managers of roads, waterways and water bodies. The judging panel praised Rainproof's innovative approach in making the city rainproof, along with the residents and people working in or on the city.


Quote from the judging panel's report:


'Whereas it has proven to be a great challenge everywhere to get cities and local authorities involved in taking specific measures, Rainproof has managed to mobilise a movement within which everyone feels responsible for each drop of rainfall, ranging from individual residents of Amsterdam's city centre to the large office complexes located in the Zuidas business district. Together, they have what it takes to gradually – through targeted measures of varying scope and size – bring about a fundamental change in our mentality toward climate change and the measures we take to counter this problem. In doing so, they provide the blueprint for public and private players throughout the Netherlands to apply this in their own communities.'


“The network approach is ultimately not about Rainproof, but about the members of the network.

Rainproof Achievements

Every drop counts

 **Expanding network**
Working with **212** partners
(**80** collaboration agreements signed)

 **15** Resident meetings

 **30** International guided tours

 **2** Prizes

10 Researches executed


Online community


 **1175** Newsletter subscribers


 **1674** Facebook-likes


 **2394** Twitter followers


Media attention


 **33** articles in (inter)national and local newspapers


 **50** articles in professional journals


 **21** mentions in television programs


 **14** radio-interviews


 **142** online media mentions


 Experienced pluvial damage


 Damage modelling

 Economic picture


 Rainproof courtyards


 Effectiveness of small-scale measures

 Focus groups with private garden owners


 Working on a rainproof city with insurers




 **100** Sessions with civil servants

 More than **100** implemented Rainproof-projects shown on map


 **20** Campaigns and events with Rainproof-contribution - 3 initiated by Rainproof


 **50** Sessions with private sector network partners


 Rainproof included in **10** important policies and as principle for public work processes


 **5x** the Waterfriendly Garden month executed with local garden centres


Developed Products


 **1** Bottleneck analysis


 **23** Area-based risk analyses


 **12** Cloudburstplans

 **57** Measures in the rainproof toolbox


 Resident meeting tutorial


 Rainproof garden tutorial

 Self-build inspiration booklet

 Professional gardeners folder

Rainproof tips included in manuals and magazines for:


 Professional gardeners

 Garden centres


 Insurance clients


 Housing association tenants


Many communication products


 **1** Digital platform


 **1** Animation


 **1** Rainproof folder

 **3** Do-it-Yourself films


 **7** Infographics with tips


 Many stickers + beachflags + banners + posters


 **1** Manual for communication products


 **20** Experience reports shared

Education

 Rainproof included in education packet 'Watergeeks'

 'Naturally Rainproof!' education-program developed with Anmec

 All applications for green schoolyards get a rainproof check

 **25** Rainproof studies by colleges and universities



Clear communication makes all the difference



**Amsterdam
Rainproof**

every drop counts



When it comes to raising broad awareness of the problem of extreme precipitation and involving the public in creating solutions, a well-designed communication strategy is essential.

We expect the government to solve all our water-related problems. But the government can no longer handle this responsibility alone now that issues related to climate change are becoming more pressing. In many Dutch cities, half of the urban area is privately owned which means businesses, property owners and residents must all be able to capture and discharge rainwater. How do you reach these people and how do you activate them?

Getting people involved

Rainproof developed a sophisticated communication strategy for this purpose, designed to identify problems and show the urgency. In other words: your house, street or neighbourhood could also unexpectedly get flooded, but there is something you can do about it.

'The challenge is to convey the kind of positive message that makes people want to join in,' says Hugo van den Bos of Total Design, which developed the strategy. 'It may start raining harder in the future, but at least we can prepare for this together.'

It's all about getting people involved. Take the payoff 'Every drop counts': 'We want you to feel that this problem concerns you too and that you can be part of the process and be a co-owner of the solutions.'

This joint approach is also reflected in the logo: a multi-coloured raindrop that unites all parties and issues. This has put the Amsterdam Rainproof 'brand' on the map.



“The challenge is to convey the kind of positive message that makes people want to join in



Community

Water-related problems tend to be complex. Total Active Media created a website that makes them comprehensible to all. It does so without any detailed explanations, it is not academic, but by being informative, inviting and mobilising.

Managing Director Martijn Arts: ‘Together we decided to go for a visual approach, with lots of clickable infographics.’ The Rainproof community keeps up to date through the website, Twitter, Facebook and newsletters. Rainproof employees respond to questions and comments received on social media. It’s all about genuine interaction, rather than one-way communication. 💧



WHAT

Rainproof your home

Ranging from water-neutral new houses to adjustments made to landmark buildings: Amsterdammers are making their homes rainproof. This way they improve the city's 'sponge effect' and prevent damage and loss.



A dry basement

Research shows that on average during extreme rainfall events homes with basements suffer twice as much financial loss as their non-basement counterparts. A resident from the De Baarsjes neighbourhood in West Amsterdam experienced this first-hand.

In July 2014, she was hit twice, with the stormwater flowing into her home following a massive downpour. Her street slopes towards her house, and the drain is located at less than half a metre from the home. The sewer system is not designed to handle these types of cloudbursts. Within no time, the street was flooded and her basement window was smashed open. Books were floating through the house, cupboards collapsed, and the carpet was completely destroyed. The total loss added up to 15,000 euros. 'Fortunately, it was covered by my insurance, although premiums did shoot up immediately after.'

In order to prevent future flooding, she purchased a wooden barrier and sand bags she could put outside her front door. She had the edge of the basement window elevated and the glass reinforced with an extra thick glass sheet. She also purchased a submersible pump, put wheels under her furniture, and replaced the floor covering in the basement with Novilon linoleum. 'I now know I can protect myself against the excess stormwater,' she says.

Sand bags and a partition protect against heavy downpours.





Sophie Verburgh at the rainproof dwelling BloemDwars.

Frank Alsema points to his underground rainwater-harvesting bag.



Three ways to harvest rain

In 2015, Sophie Verburgh and two neighbours purchased a warehouse complex between the Bloemgracht and Bloemstraat in Amsterdam's city centre. As part of their BloemDwars project, they converted the building into a studio home/cultural centre, complete with three gardens.

Water management (including stormwater management) was always problematic in this low-lying courtyard. Excess stormwater from the warehouses, adjacent rooftops and the alley would flow over the thresholds during heavy rain, right into the buildings. Sometimes the internal drains would even overflow, with sewer water coming up through the kitchen gullies.

BloemDwars used three different types of rainproof measures. Professional gardener Groenrijk installed underground Hydroblobs in two of the gardens. Connected to drainpipes, these blocks of rock wool covered with filter cloth can capture several thousands of litres of rainwater. During extended dry spells, the plants absorb water from the blocks.

SolarSedum added sedum vegetation and solar panels on the two flat roofs of the atelier and studio (around 100 square metres combined). The roof of the atelier was fitted with a water retention system. The roof can temporarily slow down 60 millilitres of stormwater during cloudburst events, thanks to Permavoid crates beneath the sedum substrate combined with an outlet that controls the flow to the downpipe.

Amsterdam Rainproof supported the coordination process with the municipality and Waternet. The residents managed to install a separate sewer system. Dirty water from the buildings drains into the sewer system, while rainwater from gardens and rooftops is discharged into the canal.

'Free' rainwater for plants and toilets

The northern Amsterdam neighbourhood of Buiksloterham serves as a testing ground for area development based on circular principles. The neighbourhood is to become a rainproof district, where a total of 73,000 cubic metres of drinking water are saved annually and 9,000 kilos of phosphate (recovered from urine) are extracted from wastewater.

Frank Alsema, a quartermaster who is building his own home, harvests rainwater for his toilet, washing machine and plants. He utilises some for his rooftop farm, while the remainder flows through a filter into an underground rainwater-harvesting bag with a capacity of 6,000 litres. It is subsequently circulated through the house through separate pipes. On the pavement outside his home are 'green tiles' from Gewildgroei and holes for direct drainage and infiltration, including room for plants.

A rooftop pond serves as detention and emergency overflow facility for when the rainwater-harvesting bag is filled to capacity. Alsema believes he will eventually be able to use his neighbours' excessive stormwater as well. The rooftop plants absorb plenty of water during periods of drought.

Rainproof likes to follow residents such as Alsema, who come up with innovative ways to separately discharge rainwater, black and grey water, and even urine. In order to allow room for innovation, Alsema and Stadslab Buiksloterham Circulair have asked the national government to create a low-regulation zone in the neighbourhood.

Next on the agenda is the sewer tax. Alsema wonders if he still needs to pay the full charge for the use of sewers when he captures his own rainwater. It's a question that is bound to come up more often as more people choose to harvest their own rainwater. In other words: to be continued... 🔥

Bringing problems and solutions to light

How do you mobilise people to make the city rainproof? By charting the problems and presenting solutions.

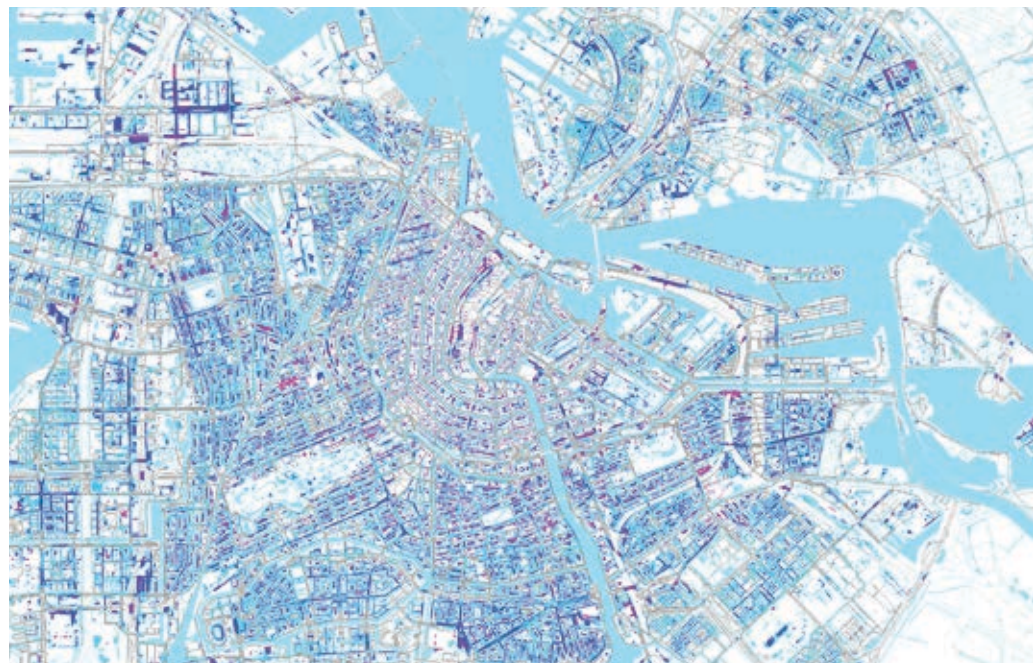
Amsterdam Rainproof has developed a number of highly practical visualisations and products in partnership with other organisations. These resources help raise the level of awareness and provide direction when selecting and implementing rainproof measures. They also show the interconnection: Stormwater doesn't stick to project boundaries, but instead flows through the entire city. Therefore, you must view rainproofness both in inter-connection and on a per area basis: Which solution will work where? And how do these solutions influence each other?

Initial stress test

How vulnerable is Amsterdam?

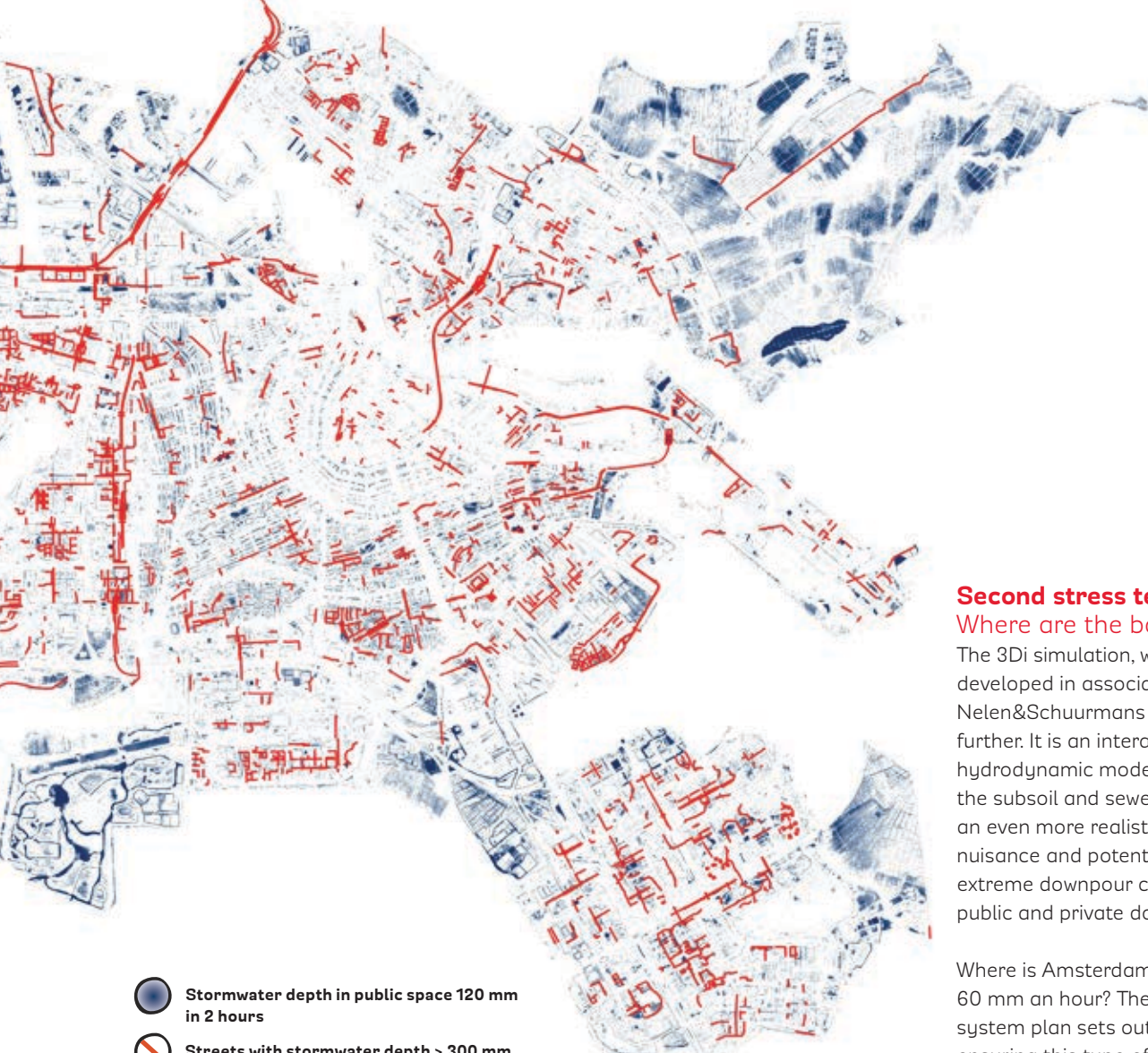
In the wake of the extreme downpour in Copenhagen in 2011 (150 mm in 90 minutes, one billion euros in damage), Waternet decided to conduct an analysis of its own city of Amsterdam: How vulnerable is Amsterdam to a cloudburst event? It partnered with the Tauw engineering firm to carry out a stress test (WOLK analysis) calculated on the basis of 100 mm an hour. The risk of damage turned out to be considerable.

This stress test showed how stormwater spreads across the surface level, but did not take the sewer system into accurate account. It did, however, clearly demonstrate the necessity of preparing Amsterdam for increasingly frequent severe downpours. It also revealed that the problems and the related damage would occur on both public and private grounds. This analysis led Waternet to start the Amsterdam Rainproof programme.



Potential stormwater accumulation for 100mm/h – Wolk Analysis





The Amsterdam 3Di-simulation takes surface levels, sub-terrain and sewer into account. This new interactive model is especially developed for the municipalities of The Hague, Rotterdam and Amsterdam.

Second stress test Where are the bottlenecks?

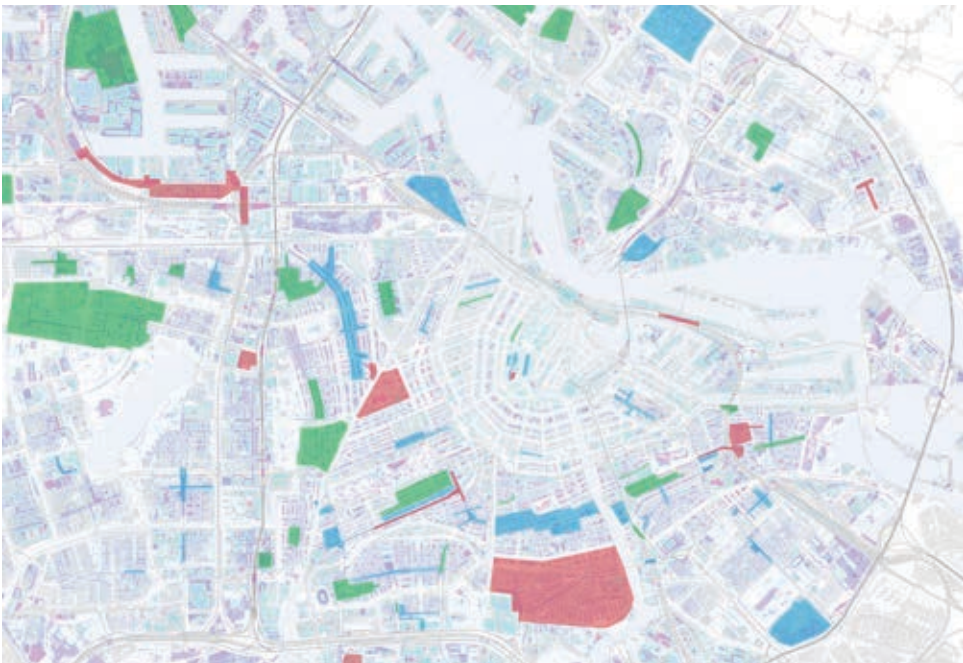
The 3Di simulation, which has been developed in association with the Nelen&Schoormans agency, goes a step further. It is an interactive and integrated hydrodynamic model that also includes the subsoil and sewer system. It provides an even more realistic picture of the nuisance and potential damage an extreme downpour can cause both in public and private domain.

Where is Amsterdam vulnerable if it rains 60 mm an hour? The municipal sewer system plan sets out the ambition of ensuring this type of downpour does not lead to damage. In order to gain even clearer insight into the vulnerability, the 3Di simulation also examines how the system would withstand 120 mm of rain in two hours.

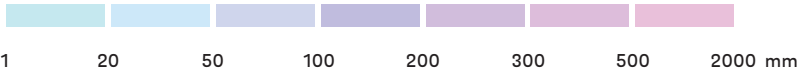
Which bottlenecks are urgent?

The streets are filled with stormwater, but how serious is this really? What are the actual bottlenecks? And where do things go wrong? A bottleneck analysis was conducted based on the 3Di simulation, GIS analyses and the input of city district experts employed by the municipality and Waternet. It revealed 97 bottlenecks in the city. The bottlenecks are subdivided into extremely urgent, very urgent and urgent. Rainproof is seeking to accelerate the process of making Amsterdam rainproof by tying in with planned works in public spaces. If extremely urgent bottlenecks are not yet scheduled to be addressed, Rainproof will attempt to move these activities forward on the schedule in consultation with the municipal district and asset managers. The maxim is: ‘Tie in with current projects, accelerate when necessary.’

- **Extremely urgent:** Risk of serious damage and disruption of accessibility
- **Very urgent:** Risk of damage and disruption of traffic
- **Urgent:** Risk of property damage



Potential stormwater accumulation for 120mm in 2 hours in bottleneck analysis

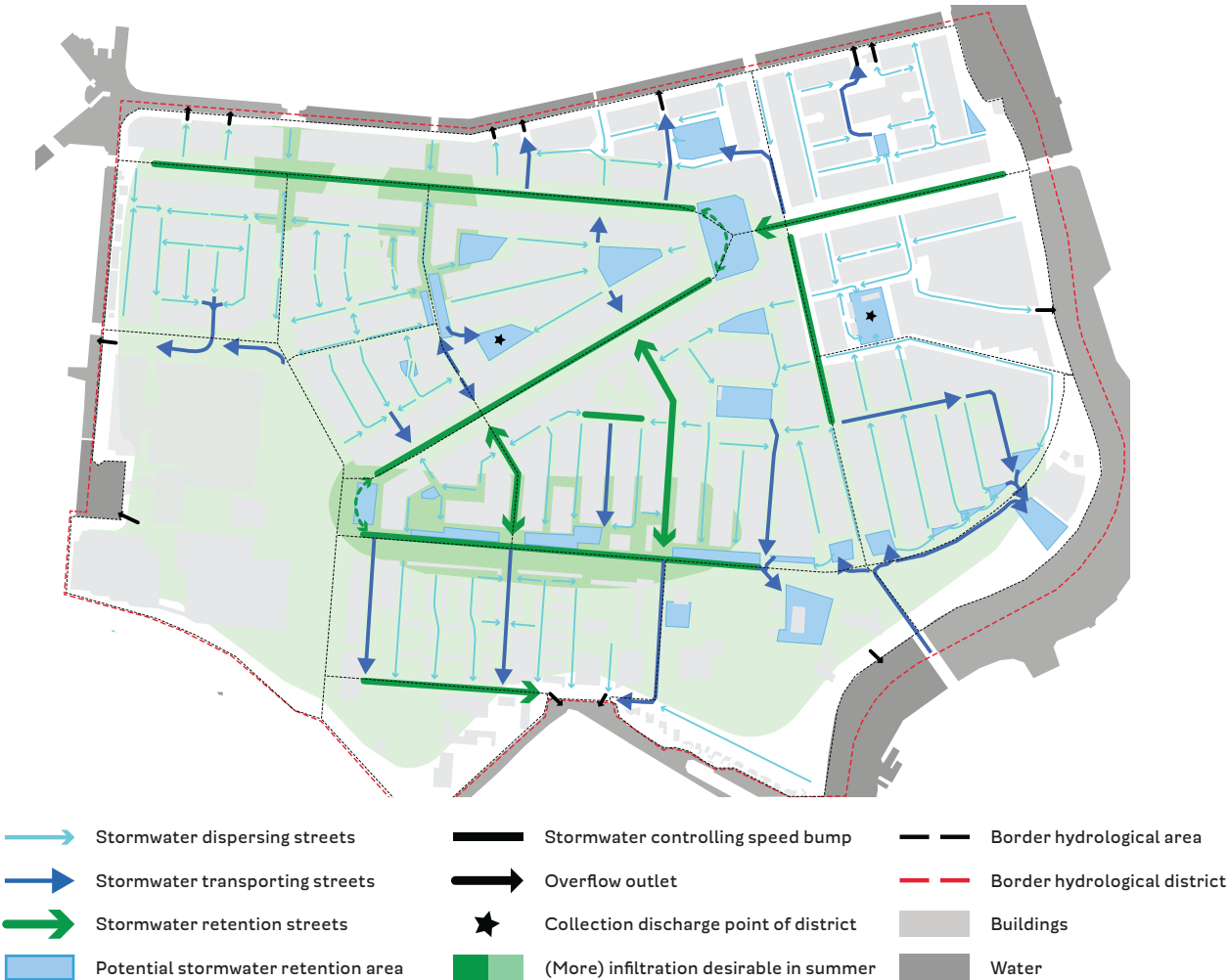


Factsheets
Charting each city district

It obviously is not enough to only tackle the bottlenecks because other parts of Amsterdam also run a risk of nuisance and damage. That's why Rainproof has developed factsheets at the Amsterdam district amalgamation level (a total of 97) and at the individual district level (a total of 23) factsheets. These factsheets chart the risk with respect to specific functions within the district, such as vital infrastructure, hospitals and police stations. These factsheets set the agenda and are used when the municipality makes district analyses of Amsterdam.



- Border district
- Risk of serious damage to vital infrastructure
- Risk of serious damage
- Risk of damage
- Stormwater bottlenecks



Where can the solutions be found?

Once you've found out where the problems are, you also want to ascertain where the solutions lie. Following the example set by the Cloudburstplan Copenhagen, Rainproof is developing 69 cloudburstplans. These cloudburstplans transcend districts and projects and are drawn up by both the municipality of Amsterdam and Waternet, together with designers, engineers and maintenance people. This process provides combined knowledge of the area and it makes a group of people co-owners of the solutions.

The cloudburstplan presents the ideal way to handle a downpour in a given district. The plans show the desired flow directions and the potential ways for water to be captured, detained, directed or infiltrated. It is a practical tool: Where can I detain the stormwater in this district? And how can my project contribute to the overall goal? While the plans are already popular with project managers and designers, there have also been calls for greater detail in the calculations and in the approaches to solutions. Currently, greater detail is added to these cloudburstplans to meet this demand.

Which measures should you choose?

Both professionals and local residents can search for rainproof measures on the Rainproof website. The toolbox has been developed in association with Atelier GroenBlauw and allows you to filter on the potential solution (draining water; using water; infiltrating water; catching and storing water and water-robust construction) and applications (for use in a building, roof or garden, street or neighbourhood, square or park). The measures are coupled with stories about local projects.

WHAT

Rainproof in the media



Preparing before the flood: Making cities rainproof is crucial
News item | 13-06-2017 | 05:29

Rain can be inconvenient. Luckily most of it disappears through the drains. Or so it seems. In reality, because of climate change and its related increased cloudburst events, there is a serious rainwater problem in many cities worldwide. Rapid urbanization with increased concrete and tarmac areas also create numerous water challenges in China's cities.

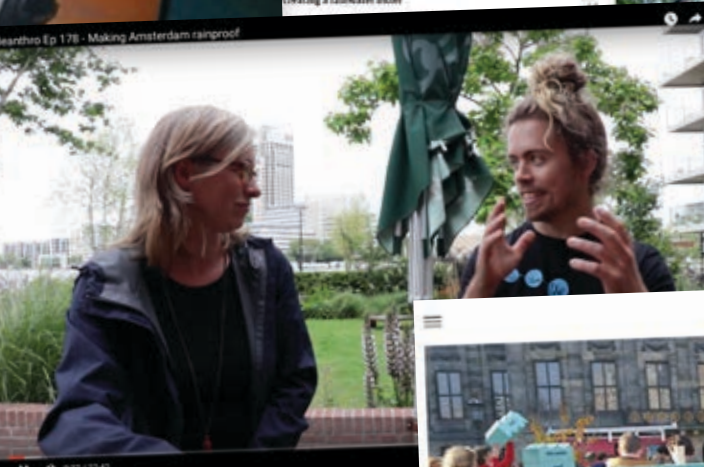


Een regenbesten OMGANG MET REGENWATER

Since the amount of rain is only likely to increase in the coming years, it forms a serious threat. Extreme rainfall over Copenhagen on 2nd of July 2011 is a prime example of this. About 150mm of rain fell in 1,5 hour creating a damage totalling to 1 billion euros. In comparison, the sewage system of Dutch

'Je moet open zijn over je eigen belangen'

Achmea en Amsterdam Rainproof legden uit hoe het beste samen op kunt trekken. Samenwerken lukt pas echt als je aan beide kanten volledig open bent over je belangen.



Klko's op de burgom om water op te vangen, systeemlatende die naar beneden komen, trams die door straten lijken te varen, wadende meten in de gangen van station Amsterdam-Zuid. Een gigantische wolkbreek zorgde in de zomer van 2014 voor een hoop ellende in de hoofdstad. Het openbare leven is behoorlijk ontwricht. Als het water is gezakt en alle plaatsen zijn opgedroogd, brengt het organisaties bij elkaar die niet van nature geneigd zijn om hun gegevens met elkaar te delen. En nu ze het wel doen, spint iedereen daar garen bij. Voor de mensen achter Amsterdam Rainproof, een initiatief van watercyclobedrijf Waternet, is het samenwerken core business. De organisatie is in 2014 opgezet om samen met bewoners, bedrijven, overheid en kennisinstellingen de stad beter te wapenen tegen overmatige regenval en het regotwater beter te benutten. Dat Achmea betrokken raakte, kwam omdat na de wolkbreek pas goed bleek dat belangrijke puzzelstukjes ontbraken, vertelt Locher. Waternet werd platgebeld door bewoners met wateroverlast. Er werd een actiecomité opgezet om al die mensen terug te bellen, hun verhalen te horen en hen te ondersteunen. We wilden leren van slachtoffers wat hadden zij meegemaakt, hoe



Amsterdam Rainproof

Amsterdam Rainproof is an initiative that works to stimulate different urban stakeholders to work together to improve water management in Amsterdam. The city is growing exponentially, and as the weather keeps changing, continues to experience heavier rainfall each year. Each resident of Amsterdam, including citizens, companies and the municipality, needs to work together to deal with the extent of

HOW

Rainproofing the city – one street at a time

How do you fully integrate rainproof measures into street design principles? The answer is by including solutions and specific materials in your manuals and policies.



“Rainproof solutions need not break the bank – we’re talking about one percent of our overall budget.

The success of a rainproof city depends entirely on rainproof streets. Ideally, we should capture as much stormwater as possible and detain it on the spot, as this will relieve the sewer system and prevent damage and financial loss. It is also a way to harvest the rainwater effectively.

Of course, all streets need to be rainproofed, but if the street is located in a bottleneck area (see p 25 for the ‘bottleneck map’), rainproof measures are unavoidable. The Rainproof cloudburst plan provides a solution, showing for each street the capabilities to detain, distribute or discharge water. The construction of speed bumps and the introduction of other measures depend on the street type, as shown on the cloudburst map.

Lateral parking

A group of designers, work planners, project managers and maintenance people employed by the municipality of Amsterdam and water cycle company Waternet recently gathered around the table in the capital’s Watergraafsmeer district – a residential neighbourhood located in a low-lying polder in east Amsterdam – to come up with rainproof solutions.

The cloudburst plan showed that one of the streets, Copernicusstraat, met the requirements for detaining stormwater. Work planner JanJaap Tenhaeff explains what measures were taken in the area. ‘By parking cars laterally instead of diagonally, it was possible to create more space in the street to store rainwater. The street is flanked by a swale which retains rainwater for a maximum of 24 hours before discharging it slowly.’

The bio retention swale – a green strip with moisture-loving plants – is only interrupted at the intersections, where the speed bumps channel the rainwater in the direction of the swale.

Lessons learned from Argonautenstraat

A pilot project carried out in Argonautenstraat, located in Amsterdam’s Stadionbuurt district, led to valuable information about maintaining infiltration systems. In summer 2015, Waternet and the South Amsterdam borough installed a filter drain in this area, known as a ‘granudrain’. Located in the middle of the concave street, it is used to infiltrate excess water during severe downpours. The facility serves as an addition to the local stormwater gullies.



Foto: Waternet

However, the filter drain soon became blocked with leaves, soil, plastic and street waste due to road works and re-grouted streets. Two key lessons learned from this experience: If possible, avoid installing the granudrain in tree-lined streets, and protect the drain until all road works have been completed. Waternet decided to follow through with the pilot project and is currently monitoring the effects of this filter drain to draft an appropriate maintenance plan.

“The sooner rainproof measures are incorporated into the design of streets and boroughs, the better.

It was a minor operation, but turned out to be more complex than it seemed, because elevated intersections are the standard across the city. Rainproof is currently striving to have two new speed bump models used as the standard in the municipal Puccini Handbook for street profiles and use of materials in the public space. These models include a flood-defence speed bump – constructed from pavement to pavement – and a water-directing speed bump, which has sloping edges so as to let the water flow past.

The local school association, Watergraafmeerse Schoolvereniging, was also inspired by the rainproof measures carried out in Copernicusstraat, and were given a ‘green’ playground featuring a swale for storing rainwater.

‘A new type of Amsterdammertje’

Rainproof’s success depends fully on the knowhow and enthusiasm of the people involved in this project, including Tenhaeff. He decided to try something new in nearby Pythagorasstraat: installing rainproof ‘mushrooms’ in a bio-retention system. These serve as overflow facilities: an outlet for stormwater during heavy showers. In addition to being useful, they add a fun, playful look to the street as well. Tenhaeff: ‘You might regard them as a new type of Amsterdammertje’ (the city’s characteristic steel traffic bollards used to separate the pavement from the street).

If it were up to him, Tenhaeff would extend his rainproof improvements from the streets to residents’ backyards. He acknowledges that this has been a slow-going process, as not all homeowners are equally enamoured of having a swale or shared drainage system installed in their backyard – not to mention the substantial costs and work involved in these efforts. Tenhaeff: ‘We have the technology to do it, but private property has turned out to be a tough hurdle for us to overcome.’

He would like it to be known that rainproof solutions need not break the bank: ‘We’re talking about one percent of our overall budget. We mainly set out to find simple solutions.’

Lessons learned from De Lairessestraat

The sooner rainproof measures are incorporated into the design of streets and boroughs, the better. De Lairessestraat in South Amsterdam, for example, was redesigned, but the design dated back to before the bottleneck analysis was carried out by Rainproof and before rainproof design was used as a standard for all types of street works.

De Lairessestraat turned out to be a bottleneck for stormwater. An analysis of the rainproofness of the new design carried out shortly before the tender showed that the new street profile could store even less water than before. In other words, the situation during cloudburst events had actually been exacerbated.

Several last-minute measures have since been introduced, including the construction of green filter strips along the bike lanes, with infiltration crates underneath. These can be used to temporarily store stormwater run-off. In addition, the storage capacity of the sewer system will be increased and additional measures will be taken for streets in the vicinity.

The main lessons learned: Use rainproofness as the basis at the outset of each new project and check in time whether a design is rainproof. This prevents headaches and having to come up with alternative (often costlier) solutions at a later stage.

Prepare for the worst

No matter how well prepared you are, there's always a risk of a downpour that is more powerful than the sewer system and all rainproof measures can collectively handle. So what do you do when faced with a cloudburst event?

The people of Amsterdam had never before experienced the kind of torrential downpours seen on 28 July 2014. A total of ninety millilitres of rain fell that day, half of which in just one hour's time. This is twice as much as the public sewer system can handle. Train station concourses were flooded, basements were filled with stormwater, streets were transformed into swimming pools, and parts of the A10 motorway had to be closed off.

Waternet received a staggering four hundred reports of rainwater flooding that day, and social media exploded with messages about flooded streets, leaks, and flooding in buildings and public facilities. It was clear that the city was in urgent need of an emergency plan for handling cloudburst events.

Special taskforce


The day after the downpour, Waternet decided to set up a special taskforce. This taskforce responded to all requests for advice and analysed all reports of rainwater flooding. It used this data to test rainwater simulations (see page 24). The analysis also included social-media messages, which contain a wealth of information about the nature and location of the problem, ranging from leaks, floods and flooded streets to problems involving public utilities and public transport.

“The lessons of 28 July 2014 have been collected in a ‘Cloudburst Management Plan’

Waternet went on to collect all these lessons in a ‘Cloudburst Management Plan’: a set of procedures for the emergency team on duty. The plan was based on procedures previously designed by Waternet for incidents such as burst pipes and technical breakdowns at pumping stations.

Inform the public before the downpour

A communication plan guarantees effective communication. The people of Amsterdam are informed about a severe downpour before it occurs. It is important to set priorities during these cloudbursts, as it is impossible to handle all reports at once. A hospital has a higher level of priority, than, say, a flooded basement in a private home.

Collecting relevant information in the control room is a must for providing accurate help. What type of flooding has occurred and where did the water originate? As soon as the storm has settled, it is time to provide effective aftercare. 

Rainproofing the neighbourhood

Team manager Marcel van Houten (l) of the municipality of Amsterdam and project manager Louis van Parera (r) of Waternet.

It's becoming the new standard: as soon as a neighbourhood is due for renovation, all plans are based on rainproof design. What are some of the challenges involved, and who are your partners?



Betondorp

As well as being renowned as the birthplace of Dutch footballer Johan Cruyff, Betondorp is also the first Amsterdam location where the municipality, Waternet and Amsterdam Rainproof worked closely together to make the district rainproof. It was a full-on process, in which designers, engineers, and managers from both Waternet and the municipality had to change the way they collaborated: by involving everyone in their plans right from the start.

Getting the partners to work together turned out to be somewhat complicated, as these organisations were used to going it alone. 'You need a couple of enthusiastic pioneers, or else you're not going to succeed,' says Marcel van Houten, who at the time was working as an operations team manager for the East Amsterdam district. 'That said, all those different parties are driven by the need for sustainable management and maintenance. This is about investing in public space for the next two decades. Any projects you take on now are with a view to the longer term.'



Foto: Waternet

Moisture-loving plants in the Harkstraat swale.

Joining forces, combining resources

The project got started more or less through serendipity. Van Houten: 'The municipality was scheduling large-scale maintenance work and wanted to replace all gas pipes.' Waternet wanted to install new sewage pipes. 'We decided to join forces and pool resources so we only had to open the road once. In this way, you cause inconvenience to residents just once.'

The streets of Betondorp received permeable pavement and a subsurface drainage system. Two streets were constructed without gullies. The most remarkable new feature is the swale located on Harkstraat: a green strip for detaining stormwater run-off. Moisture-loving plants contribute to biodiversity and their roots allow for superior stormwater infiltration.

Tim Boogaard, project manager for large maintenance in Betondorp, explains that residents were by no means neglected in the plans, although it took some time to persuade them that a swale is something quite different from a pond or a mosquito-filled swamp. 'But when residents heard that the field would be inundated with water sporadically and for a maximum of 24 hours only, they approved.' As is often the case, good communication turned out to be half the battle.

“You need a couple of enthusiastic pioneers, or else you're not going to succeed

Shared interests

Boogaard believes the key to the project's success has been the collaboration between multiple parties with shared interests. Yet there is no blueprint and each location is different. 'You look at the situation and wonder how you can do things differently in a simple way, without needing to spend extra money. You assess each site and come up with the smartest solution, and decide which individuals and organisations you need to get involved.'

'Harkstraat is a good example. We had to carry out work in the area anyway, so why wouldn't you explore smart new ways of discharging stormwater? If you're going to be innovative, you shouldn't be afraid to break away from the beaten path. It's OK not to know the outcome of everything and just keep going.'

The Betondorp approach attracted its share of attention, even receiving the Peilstok 2014 award, presented by the Netherlands Ministry for Infrastructure and the Environment for inspiring solutions to make the built area more resilient to flooding and climate events. →



Project leader John Tel and area coordinator Thea Kroes.

“The cloudburst plan instantly made rainproof the standard for all plans’.

De Bellamybuurt

The Bellamybuurt district in Old West Amsterdam is a nineteenth-century, highly urbanised neighbourhood located in a former low-lying polder. Ditches in the area were levelled many years ago, parts of the sewer system are obsolete, and the area is virtually deprived of green spaces and open water. So it's not surprising that a bottleneck analysis (see p. 25) conducted by Rainproof revealed conditions in the district to be 'extremely urgent'. During heavy downpours, the stormwater sometimes floods into residents' homes.

The district was slated for large-scale renovation in 2016, but not everyone acknowledged the need for rainproof facilities in the new set-up. Partners Rainproof and Waternet, working with a team of designers, engineers and project managers, therefore created a detailed cloudburst plan. The team analysed where the stormwater run-off accumulates and how it might be discharged.

'The cloudburst plan instantly made rainproof procedures the standard for all plans; we were all on the same page and could get started right away,' says project leader John Tel of the engineering firm of the municipality of Amsterdam. Rainproof has become the new benchmark.


Bellamystraat collects all the stormwater of the neighbourhood. On account of its low-lying position, the stormwater run-off cannot flow to the adjacent open water of Kostverlorenvaart. A second pump had been installed underneath Bellamystraat in the past, but this solution turned out insufficient. The street profile is therefore being deepened, creating more room for detaining stormwater. By using speed bumps to serve as 'small dikes', excess stormwater is transported toward the open water of the Tweede Kostverlorenvaart or to sites where it is temporarily detained. Tel refers to this as 'playing with water'.

The Bellamyplein area will be home to a sustainable urban drainage system in the form of a bio-detention strip which will be built around the square, will flood only during heavy downpours, and will temporarily store rainwater and 'slow it down' before it enters the sewer system. Finally, as part of the new Hasebroekstraat design, several playgrounds will also be used for stormwater detention.

Support from residents

When an entire neighbourhood is overhauled, the support of the local residents is vital, not least because a large part of the city consists of privately owned area. This is even more the case if you solve the problems aboveground, in a highly urbanised district which already has a lack of public space for residents. Area coordinator Thea Kroes therefore organised several public consultation meetings to involve residents in the plans.

Kroes: 'People have been personally affected by flooding in their homes and are keen to help us come up with solutions.' This has resulted in residents presenting their own initiatives, for example by 'greening' their walls and rooftops so as to capture more rainwater. The municipality and Waternet are also encouraging residents to get involved in the renovation of the old polder sewers in their courtyards.

Residents are also helping to plan the redesign of the area's squares and streets. Project leader John Tel has witnessed this up close: 'There are groups of residents who hold three or four meetings to discuss how their street should be redesigned.' 

HOW

Rainproof as the standard



Rainproof steering committee fltr: Geertje Wijten (replacing Marloes Michels, Space and Sustainability), Renze van Houten (Waternet), Jean-Paul Rocour (Traffic and Public Space) and Marten Klein (Engineering Firm).

In order to prevent the success of the Rainproof mission from remaining dependent on a handful of inspired trailblazers, it needs to become one of the cornerstones of municipal policies and procedures. But how to get there?

Stormwater flows through everything and knows no boundaries: it's unhindered by project borders and organisational departments. That's why the rainproof city calls for a new strategy of both the municipality and Waternet.

'Making the city rainproof is such a priority that it extends across all domains. It is larger than the individual water management company or the sewer company. In fact, the road management company may be the largest stormwater management firm in the city,' says Marten Klein, managing director of the engineering firm of Amsterdam and a member of the Rainproof steering committee. 'My engineering firm and the department of Space and Sustainability are working steadily on designing the city. It needs to be a shared effort, you can't do it on your own.'

In order to allow the various departments and services to create the rainproof city together, Rainproof took stock of all relevant policy documents and operating processes. If you want to see rainproof practices added to the agenda, you need to involve everyone who has a say in how the city is designed and constructed. This includes designers, technicians, work planners and maintenance people, in addition to the more obvious categories of policymakers and project managers. Rather than contacting them all individually, you need to approach key figures: people who are enthusiastic and open to new ideas and who can share the Rainproof-message with their co-workers.

But talking is not enough: in order to put rainproof principles into practice, they need to be an explicit part of the policy. When the time comes to draft new long-term reports or area plans, you need to make sure you are right there at the negotiation table. This active approach has ensured that rainproof solutions have been a prerequisite in many policy documents over the past four years [see box].

Rainproof as the basis

'Rainproof design is one of the criteria on which we evaluate project applications,' says Cas Poldermans, executive secretary of the Department of Traffic and Public Space of the municipality of Amsterdam.

But there is always room for improvement: Amsterdam is not at the stage where all streets and squares are designed based on rainproof principles, even though the Municipal Sewer System Management Plan provides that the city should be able to process a 60mm/hour downpour without sustaining any damage.

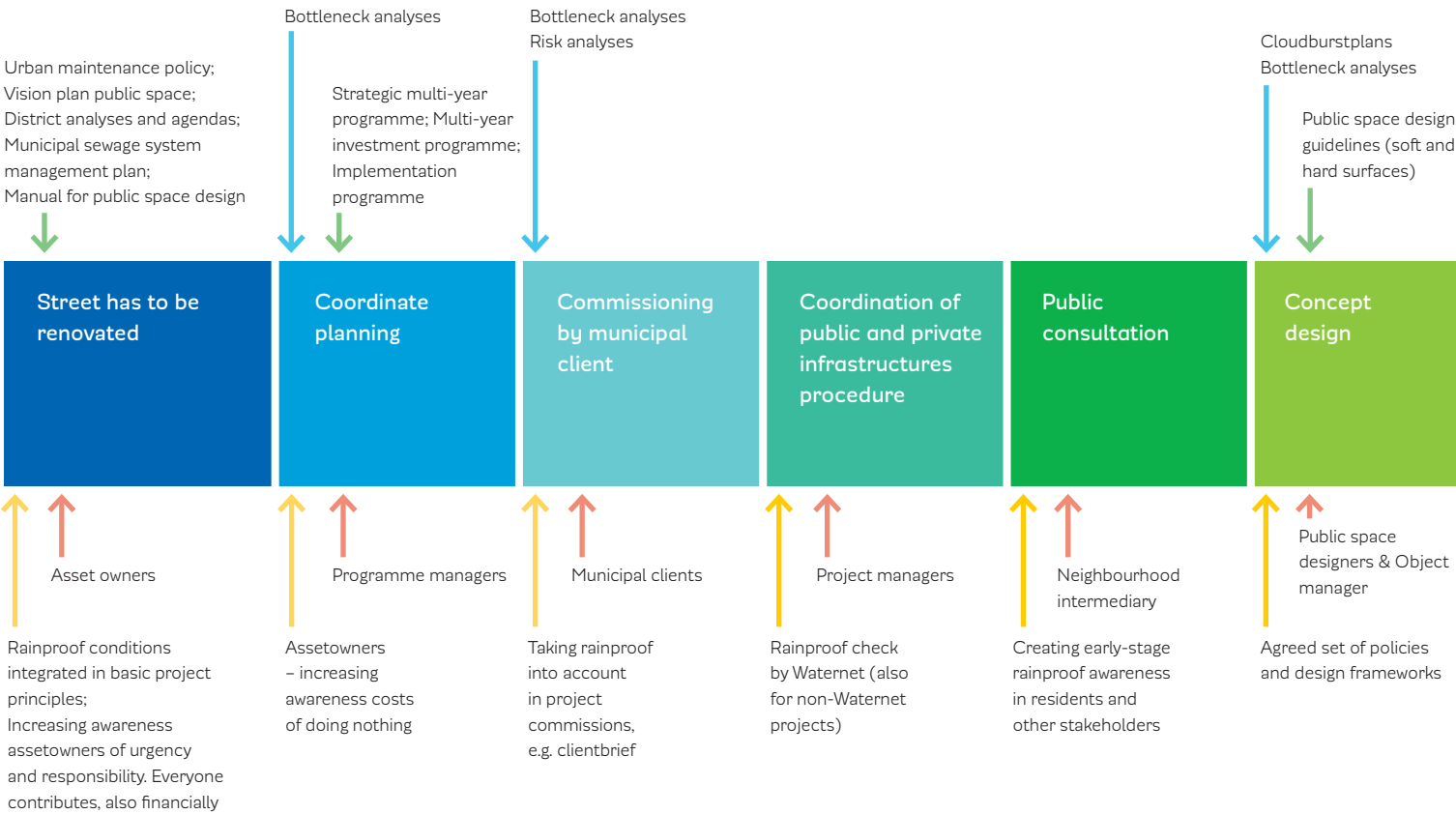
'We still see road works being performed in some areas, where it doesn't occur to anyone to use a new rainproof street profile,' says Jean-Paul Rocour, Director of the Traffic and Public Space department and a member of the Rainproof Steering Committee. 'Rainproof design should be much more explicitly included as a prerequisite in the choice of materials.'

The main hurdle is the fact that so many different aspects need to be considered in designing the city; rainproof practices are just one of many objectives. What does help is that rainproof principles have been integrated into the national Delta Plan on Spatial Adaptation, which highlights the Rainproof approach as an example. This has prompted the City of Amsterdam to turn its focus to climate adaptation. The Rainproof steering committee, which includes representatives from Waternet and the municipality, is also valuable in ensuring that rainproof principles remain on the agenda – and, even more importantly, that they are implemented.

Ideal situation of mainstreaming rainproof in public policies and municipal work-processes

Concept analysis* of residential street renovation

* Analysis is a snapshot – processes, responsibilities and policies are in constant flux



What has been made official to date?

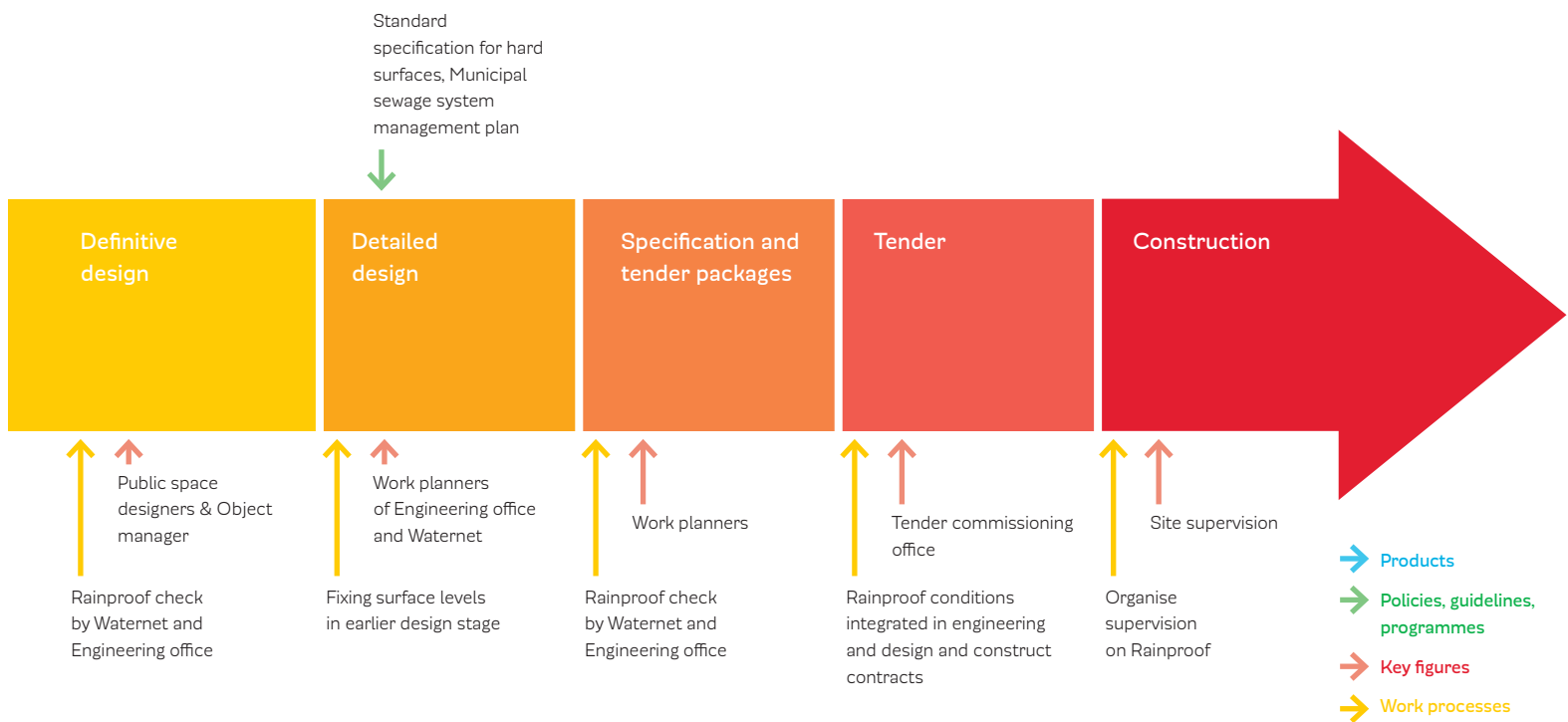
- ✓ The municipal Sewage System Management Plan provides that, by 2020, the city must be able to process a 60mm/hour cloudburst without incurring any damage to homes and vital infrastructure.
- ✓ The Public Space Vision Plan states that rainproof design is the standard throughout the city.
- ✓ The Sustainability and Green white papers of Amsterdam are investigating in conjunction with Rainproof which areas can be greened, reducing the amount of concrete, and how this might be encouraged.
- ✓ During maintenance work, as many modifications as possible are made to promote a rainproof design, in accordance with the 1Amsterdam Heel & Schoon ('One Amsterdam, Intact and Clean') policy framework.
- ✓ Rainproof design is a prerequisite for new area development on Zuidas and Centrumeiland districts, including water-neutral development briefs.
- ✓ The 2017 Plan and Decision-Making Process for Spatial Measures ('Plaberum') states that Rainproof measures must be incorporated into urban development.
- ✓ The Puccini policy framework (for designing public space) incorporates Rainproof-solutions.
- ✓ Rainproof forms part of the standard specification for hard surfaces.
- ✓ Rainproof is one of the fundamentals of the City's multi-year investment programme. Project applications are assessed partly on this basis.
- ✓ The specialised study on Rainproof Area Development answers the question 'How can we integrate rainproof principles and design into the city's transformation and urban densification challenge?'

New approach

Amsterdam Rainproof requires a different approach on the part of both the municipality and the water management company. Waternet intends to change its traditional role and apply rainproof practices across the board. This is why the Rainproof-team – which used to operate from its own office – moved to Waternet office in 2017 in closer proximity to the municipal and Waternet organisations.

This physical proximity makes it easier for them to share their knowledge and experience with the network-based approach with their colleagues.

'The Rainproof programme was successful early on because we set it up outside the remit of the organisation. One of their strengths was their independence,' says Renze van Houten, who, in addition to being managing director of Waternet, chairs the steering committee and is Rainproof's client. 'Sure, policy is important, but having a clear mission and a dedicated team of people who have the right attitude and are able to involve others matters at least as much.' That's why it's important that the members of the Rainproof-team work right alongside their Waternet colleagues. Van Houten assures that they don't have to start practising change management just yet: 'The main thing I tell them is to stay a little rebellious. Rainproof's success hinges on a strong team of people with the right kind of attitude, who can involve their communities, who are media-savvy and who know when to celebrate successes.' 💧



WHO

Every garden counts

Amsterdam Rainproof works closely with garden centres, landscapers, product developers and housing associations to make as many gardens rainproof as possible.



“Rainwater has really become a hot topic over the past four years

Rob Franken
Van der Tol



“You need to promote and push the topic

Brenda Horstra
Tuinbranche Nederland

No lecturing

Gardens have great potential when it comes to rainwater harvesting. But how do you get that message across to garden owners? The answer: by entering into long-term partnerships with liaisons. As part of its awareness campaign, Rainproof contacted garden centres, businesses operating in the gardening industry, landscapers, product developers and housing associations.

Since the issue of rainwater wasn't yet on the radar of garden centres, Rainproof hosted a series of meetings with garden owners back in 2015, during which the topic was given the attention it merited. Both the customers and garden centres who took part in focus groups expressed an interest in rainwater management through raingardens. But the problem turned out to be a lack of products and knowledge to provide customers with proper advice.

‘You need to promote and push the topic constantly,’ says Brenda Horstra, deputy director of Tuinbranche Nederland, the industry association for garden centres and their suppliers. ‘We talk to a lot of garden centres and suppliers. For example, we create “trend gardens”, including the “water-friendly garden,” to inspire people.’

Meetings with Rainproof and the information gathered from the focus groups helped rainwater to become one of the strategic topics for the Tuinbranche. Together they organised the campaign *Natuurlijk! De Watervriendelijke tuin* (‘Naturally, the water-friendly garden’). Rainproof shares its knowhow and communication materials with its partners, as well as targeting local garden centres. According to Horstra, these efforts have paid off: ‘Rainwater management and reuse has really become a priority, also among consumers.’

Dutch celebrity gardener Lodewijk Hoekstra stresses the importance of giving people an incentive to take action. His company, NL Greenlabel, is developing a sustainability label for products, materials and entire geographic areas. ‘If you want to get as many people as possible involved in making their gardens or communities more sustainable, you shouldn't lecture them but help them think in terms of solutions,’ he says. Hoekstra teamed up with Amsterdam Rainproof in conceiving and developing events such as the Rave & Ride pop-up park on Amsterdam's Dam Square (see p. 15), campaigns such as *De Levende Tuin* (‘the Living Garden’), and hosting product innovation sessions for new sustainable products such as a ‘rooftile dam’ and an environmentally friendly green drainpipe. ➔

“We got involved in the project because sustainability matters to us

Timme Wielinga
Intratuin



‘My garden is too wet’

One of the most frequently heard questions at the Intratuin garden centre in East Amsterdam is: ‘My garden is too wet – what should I do?’ Although demand for advice, rain barrels and other rainwater-related products is growing steadily, store manager Timme Wielinga acknowledges that sales aren’t exactly through the roof. Demand appears to depend on a heavy downpour, or a hurricane or tropical cyclone overseas.

In an effort to boost demand for rainwater-related products, Intratuin joined forces with Amsterdam Rainproof to build a showmodel of a rainproof garden with a disconnected drainpipe, a rain barrel, a gully and a pond, layers of gravel, and a shed with a green roof. Rainproof has also distributed information posters throughout the garden centre.

The store assistants were given the opportunity to update their knowledge of the subject during special Rainproof sessions held after hours, to help them accurately answer customer questions. Wielinga: ‘We got involved in the project because sustainability matters to us.’

Questions about ‘greening’ and water storage

Gardeners also play a vital role in advising garden owners, and Rainproof has partnered with Van der Tol, one of the largest landscapers in the Netherlands.

‘Rainwater has really become a hot topic over the past four years,’ says managing director Rob Franken. ‘We are all becoming aware that climate change leads to more rain, and that those in urban areas are compelled to harvest it. Our landscaping business receives a lot of questions about this from the public.’ As an example, he cites a newly developed complex in Amsterdam’s IJburg district, where sustainability and water storage were a priority from the start. ‘The housing association asked how they could harvest and detain rainwater from the rooftops.’ Van der Tol constructed a water-detaining roof garden, a swale at ground level in which the water is infiltrated, as well as designing small rivulets in the courtyards.

The company works in accordance with the Ecocad (‘EcoCity’) principle, which presents green solutions to environmental problems in urban areas. Water storage is one of the key elements of this approach.

Franken: ‘Rainproof is our partner in this project. They can provide handy infographics and calculations, we have a lot of practical knowledge on this subject which we can share with them.’

“Help people think in terms of solutions

Lodewijk Hoekstra
NL Greenlabel



“The water-garden action deserves a follow-up

Dorella van Stavel
Ymere

Renovating gardens in Betondorp

Since not everyone has the knowledge, time or financial resources available to rainproof their garden themselves, housing association Ymere, Intratuin Amsterdam, stichting Sociaal Tuinieren, Stichting Present and Amsterdam Rainproof have launched a water-garden action in the Betondorp district in East Amsterdam.

Betondorp is home to a relatively large number of senior citizens and low-income households who are often unable to maintain their own gardens, explains community coordinator Dorella van Stavel of the Ymere housing corporation. For these people, pavement seem like the perfect solution. ‘While they may seem low-maintenance, they really aren’t.’ Not only do pavers become soiled and overtaken by weeds, the rain doesn’t have anywhere to run off to in those gardens, causing the garden and street to be flooded in no time.

To prevent this situation, a few dozen gardens were given a makeover as part of a one-day campaign. Van Stavel: ‘The concept was rainproof and community-oriented and improves the quality of life in the area.’ The residents loved the initiative and enjoyed getting involved, she says. ‘They’re still talking about it.’ Van Stavel agrees that the water-garden action deserves a follow-up.

Rainproof is currently developing a plan for future water-garden actions together with housing associations, garden centres, volunteer organisations and rainwater experts. [D](#)

An economic picture

How much does a rainproof city cost? Who will foot the bill? And what does it cost to do nothing? Amsterdam Rainproof's economic picture provides answers to these basic questions to mobilise stakeholders.



The economic picture reveals four aspects: the financial losses of taking no action at all; the effectiveness of rainproof measures; the revenues generated by these measures, and the additional expenses created for the city as a whole. The picture also shows the benefit of integrating rainproof solutions into all physical modifications carried out in the city.

The information is displayed in at-a-glance infographics, combining both quantitative calculations and more approximate, qualitative costs and benefits. For the city's residents, losses are not just financial in nature – there's an emotional component involved as well. And a rainproof city does not only prevent nuisance and loss, but is also conducive to Amsterdam's image as a sustainable, future-proof city, attractive to businesses and residents. While it may not be possible to quantify this by providing exact data, it is important to include this data in the assessment. The method for developing this economic picture was created in association with the RebelGroup consultancy firm.

The economic picture is currently 'in progress', as the accuracy and effectiveness of the picture still needs to be tested by several experts. But Rainproof is keen to share some outcomes at this relatively early stage, as the preparations have already led to some interesting insights into the effectiveness of various measures, along with the costs and benefits involved. In addition, the involvement of experts has already helped to create a shared sense of ownership. The ultimate objective of these efforts is, of course, to get more people to actively support the rainproof city. Below, each element of the economic picture is explained.

PART 1

What is the potential loss if no measures are taken?

To find out what the costs and gains are of a rainproof city, you need a reference. The first questions to ask should therefore be: Just how detrimental will it be if we take no action at all, and what is the total damage for the city after a severe downpour? The engineering firm Tauw made a loss estimate for this 'zero scenario' for Amsterdam, based on a downpour of 60mm/hour, the new basis for the municipal sewer system plan. Just to give you an idea: the Amsterdam sewers can handle an average of 20mm/hour, which means the remaining 40mm/hour must be detained at ground level or on building rooftops.

The loss estimate shows the potential direct, indirect and public damage, factoring in geographic location along with specific features such as the presence of thresholds and basements. Where possible, the loss has been quantified in a model based on euros per square metre. For Amsterdam, this resulted in an estimate of between 10 and 500 million euros in damage during a downpour of 60mm/hour. This is a rough estimate: the value of items stored in people's basements, for instance, can vary significantly. →

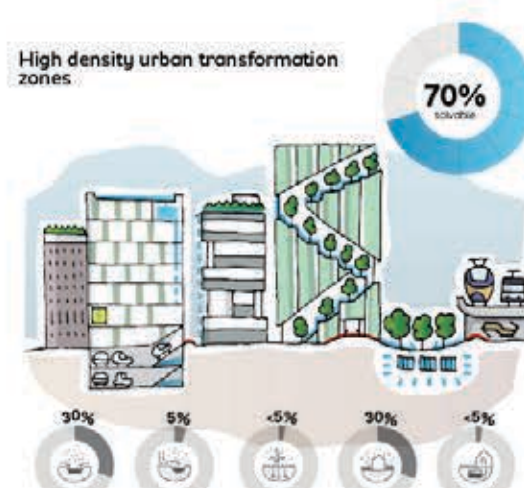
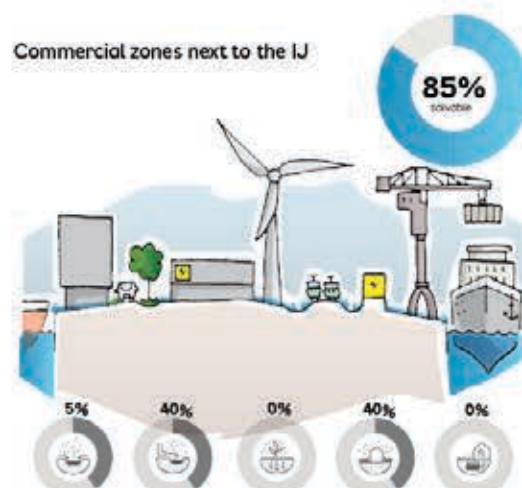
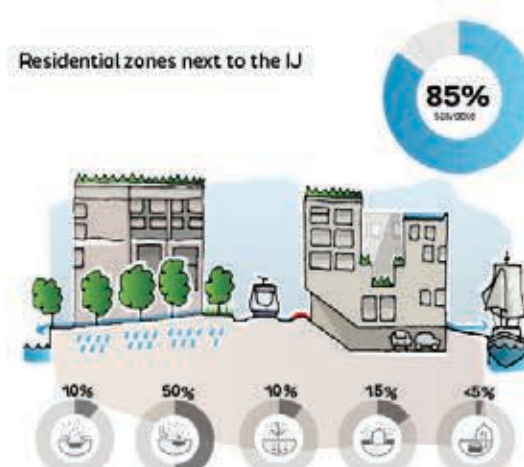
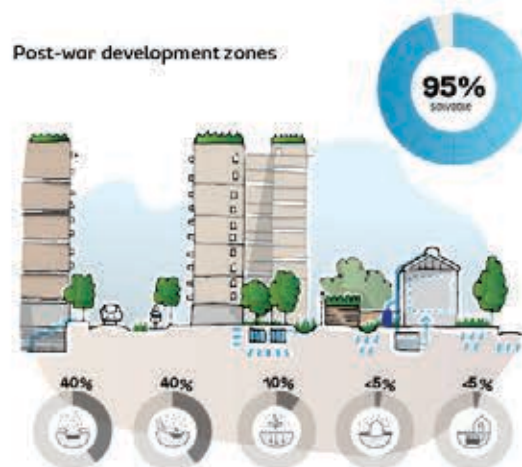
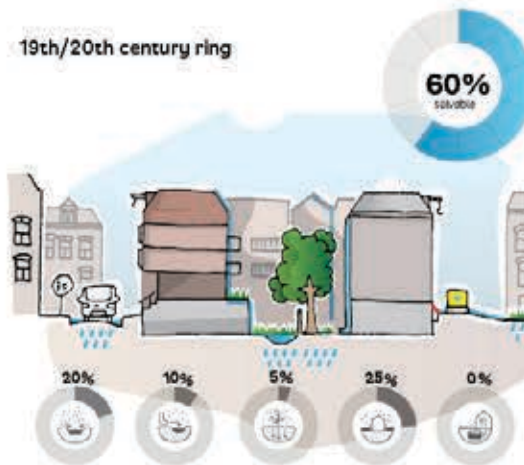
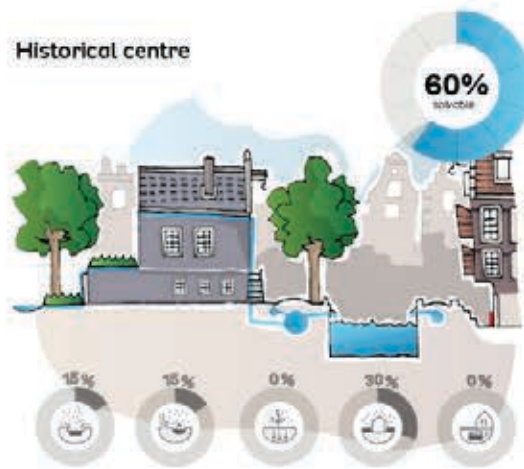


PART 2

How much can we solve?

Effectiveness by neighbourhood typology when integrating rainproof measures in scheduled work

The second part shows how you can make the city rainproof using effective resources: what solutions are most appropriate for which types of neighbourhoods? The Amsterdam Rainproof website currently lists 57 rainproof measures, broken down into five potential solutions, ranging from stormwater detention and retention to discharge, infiltration, stormwater-resistant constructions and water harvesting. These measures have been applied to six neighbourhood types, ranging from the historic city centre to high-rise conversion areas. This neighbourhood typology is based on physical, technical and social characteristics and was created together with experts. The measures show, for example, that in the 19th- and 20th-century ring around the city, every opportunity must be used to achieve the highest possible level of effectiveness. A total of sixty per cent of the damage can be prevented by integrating rainproof measures into future projects. The post-war neighbourhoods offer more scope for choice between the various measures.

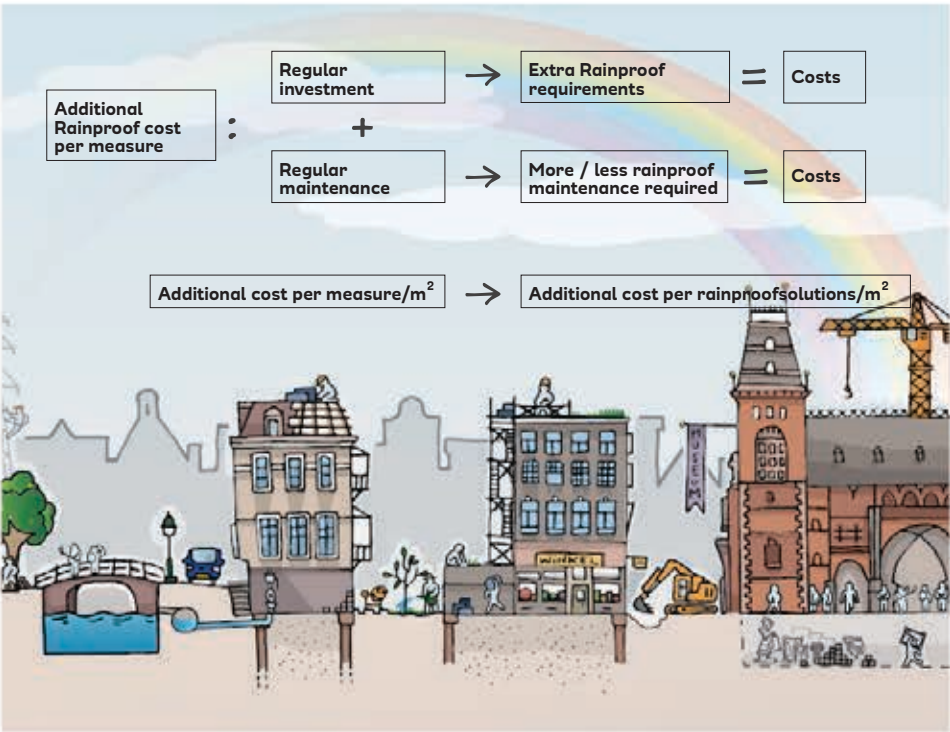


PART 3

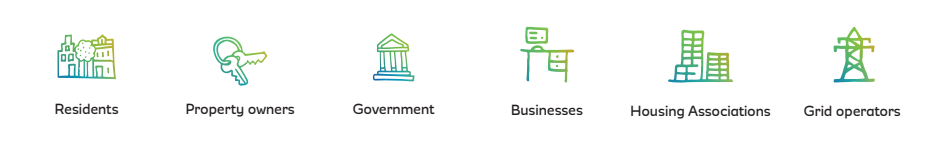
What are the costs?

Additional investment and management expenses

After homing in on individual neighbourhoods, we zoom out again to focus on the city as a whole. Part 3 shows the additional expenses involved in implementing rainproof measures. Since our approach in Amsterdam is based on the smart integration of rainproof measures into scheduled works, we focus on additional expenses; that is, additional investment costs and additional maintenance costs. For example, the construction of bio-retention zones generates additional expenses for the excavation and deposit of soil, as well as higher maintenance costs for maintaining the plants. However, these citywide additional expenses are always approximations. While investment costs per measure may be clear, the data for maintenance expenses is more variegated. There are different methods for calculating maintenance costs, and the boundary between regular and additional maintenance costs is not always clear.



Distribution of cost per stakeholder

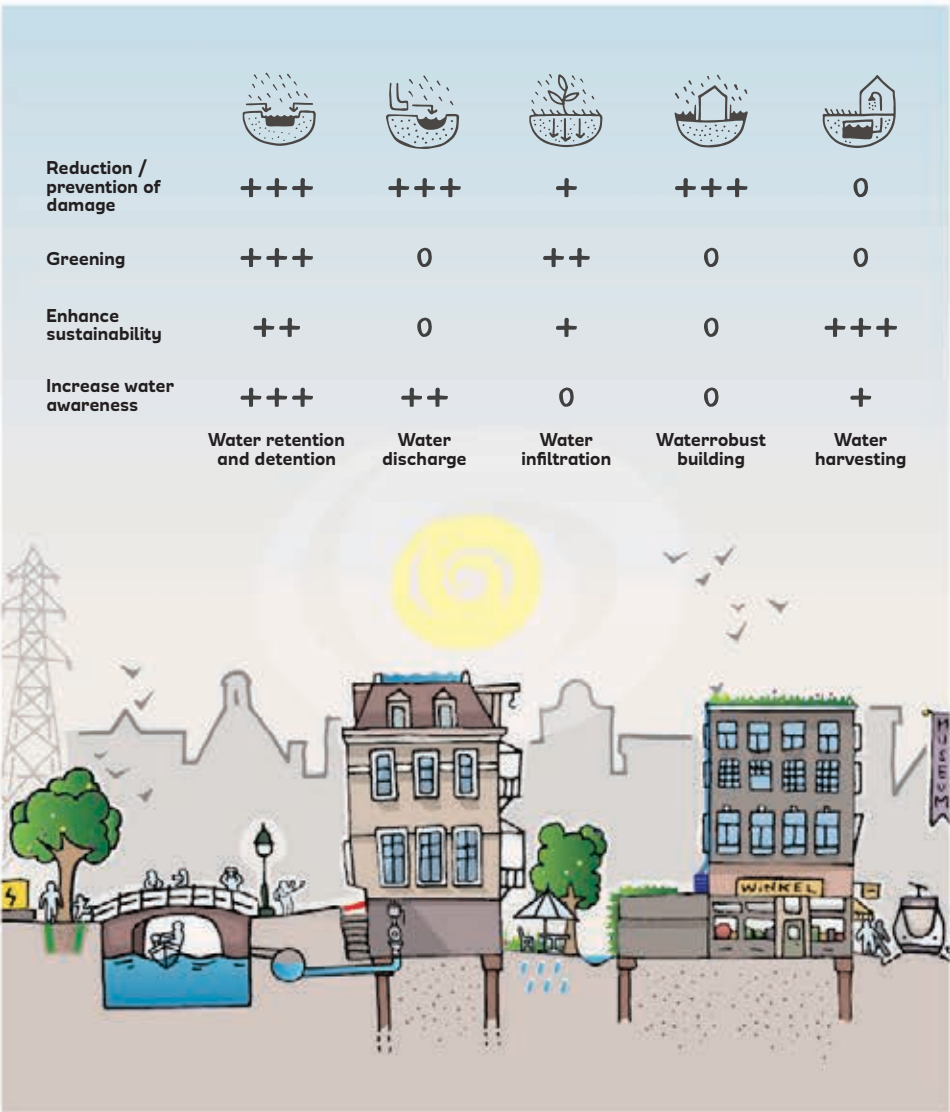


PART 4

What are the returns?

The gains of a rainproof city

Part 4 answers the question as to how much damage you might prevent by integrating rainproof solutions into scheduled works carried out around the city. Experience has shown that such integration alone is not sufficient to reduce hundred per cent of the damage. In other words, this is another argument to speed up the process of resolving the stormwater bottlenecks. Part 4 also shows the percentage by which damage is reduced in the city as a whole, and what the other benefits are of each solution and for each party concerned. That is to say, a single solution can lead to different benefits: in addition to reducing or preventing damage, they make the city greener and more sustainable while at the same time raising public awareness of water usage. If we look at these various benefits, we see that specific solutions contribute more than others. Water-resistant construction, for example, is highly effective when it comes to preventing water nuisance and reducing damage and loss, but thresholds for front doors and rainproof construction methods do not offer any other benefits. Stormwater retention and detention measures also make the city greener and more attractive. ♡



Smart roofs, smart rain barrels

Smart systems help rooftops and rain barrels to capture, control and discharge even more rainwater, improving the city's 'sponge effect'.



Every drop counts' is the motto adopted by Amsterdam Rainproof, and this is certainly true for rooftops and rain barrels. Rooftops, especially, have the capacity to detain and attenuate large quantities of rainwater on the spot. The storage capacity of rooftops and barrels can be increased by linking these barrels and rooftops online and making them readable and controllable remotely.

There is certainly no shortage of opportunities: Amsterdam alone provides twelve square kilometres of rooftop space. The municipality and Waternet are promoting the construction of blue-green rooftops by providing subsidies and technical support, respectively.

Rain as raw material instead of waste

'Rainwater is a raw material and does not qualify as waste. We need to stop automatically discharging rainwater to the sewer system.' Friso Klapwijk is managing director of De Dakdokters ('The Roofdoctors'), a company specialising in the installation of roof gardens and 'green' roof terraces. His company and Waternet created the first Polderdak (polder roof) back in 2013: a dynamically controlled green-blue rooftop installed on top of a cultural incubator located in a school building in Amsterdam's Zuidas business district.

A dike is installed on top of the polder roof to stop the rainwater. An innovative piece of valve technology ensures that the rainwater is discharged in controlled quantities in anticipation of the next downpour to increase the roof's retention capacity. Sensors check the amount of water and the temperature on the rooftop. Klapwijk: 'The polder roof was essentially the answer to a question that hadn't been asked yet, but now a growing number of businesses and governments are showing an interest in this system.'

The Smartroof 2.0 was installed on the Amsterdam Marineterrein (Maritime Site), a testing ground for polder roofs. This green-blue polder roof is equipped with a total of seventy sensors, which register for instance the roof's water management and cooling capacity. The data is then compared with that for traditional black roofs.

Massive money-saving opportunities

According to Klapwijk, green-blue roofs provide excellent cost-cutting opportunities. Toilets and sprinkler systems are just two ways in which rainwater can be used. 'Ninety percent of water consumption in office buildings is related to toilet use. That's one area where you can really make a difference.' The Dutch National Postcode Lottery will be adapting this use of rainwater accordingly at its Amsterdam head office.

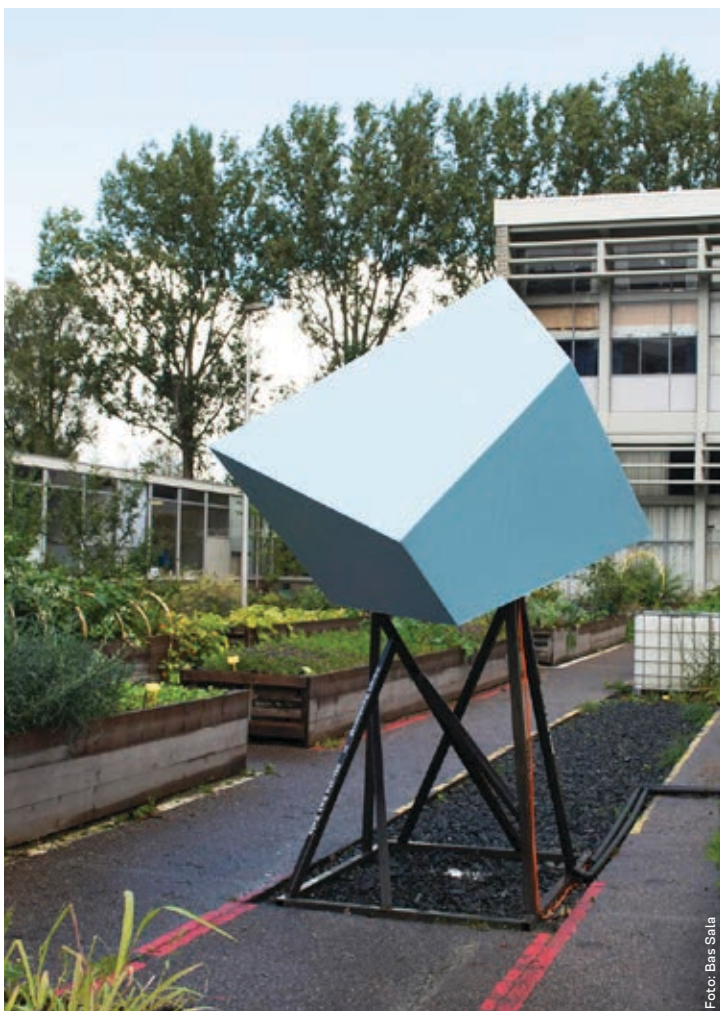
A polder roof also helps to cut heating and cooling costs. Klapwijk: 'The water and vegetation on the roof ensure that temperatures don't rise above twenty-five degrees. A black rooftop can reach temperatures of up to sixty degrees during the summer months and zero degrees in the winter. If we blow the carbon dioxide from the building along the roots of plants, we can purify the air in a completely natural way.'

Smart rain barrel

Smart rain barrels contribute to the city's 'sponge effect'. They are connected to an it-network which is attuned to the local weather forecast and are equipped with a valve you can control online. This ensures optimum usage: filled with water during dry periods and empty before it starts pouring down. 'Our systems are interchangeable; we can basically control everything. This means the smart rain barrel can be connected to a smart rooftop,' says designer Bas Sala.



The first *polder* roof in The Netherlands on top of Old School at Zuidas district.



The stunning blue rain barrel by Studio Sala.



A remotely controlled *polder* roof system.

Sala intends to use the smart rain barrel to integrate the Internet of Things (devices connected to each other online) into water management. He is currently testing the smart rain barrel in Amsterdam, Rotterdam and Schiedam. There is an eye-catching blue rain barrel inside the PlantageLab behind the WOW hostel in West Amsterdam.

Sala: 'People really respond to the design. That's because it's not just a technical solution, but a highly visual one as well. You make sure the problem is addressed and that people become aware of it.' Contemporary design and smart technologies are perfect for educating the public on climate adaptation while providing solutions at the same time.

WHO

"We want to make
rainwater-usage and
nature accessible
to everyone."

Intratuin

Our Rainproof Partners

Gardeners and Garden Centers

Anmec
Balkenende hoveniers
Branchevereniging VHG
Bond van volkstuinders
De Dakdokters
Donkergroen
Eeden Groenadvies
Greenroof Management
Groen als Bas
Groenrijk
GrownDownTown
Hornbach
Intratuin
IVN
Juro Support

Nederveen Tuinen
Praxis
Rooflife
Sanne Horn
Stichting Groei en Bloei
Van der Tol
Tuinbranche Nederland
Tuintje van mijn Hart

Design and Engineering Consultants

Advin
Atelier Groenblauw
Arcadis
Buro regen & water
Delva Landscape Architects
Metabolic
Nelen & Schuurmans
New Energy Docks
Tauw
UrbanBoost

Knowledge institutes

AMS
Deltares
Hanze Hogeschool
Hogeschool van Amsterdam
Hogeschool Rotterdam
KNMI
RIONED
Stowa
TU Delft
UvA
VU
Wageningen UR
Wellantcollege

Entrepreneurs and insurers

Achmea
Aquaflow
Balkonton
Bas Sala
Centraal Beheer
De Hamer
De Wilde BV
Drainvast
Dura Vermeer
GEP rain
Greensand
Installateur Warm/Koud
Mijn Waterfabriek
NL Greenlabel

Rainwinner
Rainbeer
Rain(a)Way
Struyk Verwo
Solar Sedum
Securitas
StreetAds
Sempergreen
Van Gelder
Verbond van Verzekeraars
Waterblock
Waterstopper

"The Rainproof
network makes it
possible to share
knowledge with
a wider audience."

Wageningen UR

"The effective
combination of
rainwater with
green is essential
for a liveable city."

Sempergreen

"A Rainproof city
is a forward-
thinking city."

Knowledge Mile

"Making the city
rainproof is
essential in the
transition to a
circular city."

Metabolic

"We make an effort to
inform the local
community and help
them prevent flood
damage."

Ik Geef om de Jan Eef

Developers and Real Estate Owners



de Alliantie
Amsterdamse Federatie
van Woningcorporatie
Breevast
De Key
Eigen Haard
Rochdale
Stadgenoot
Ymere



Civil society

Batjan Buren
Boloboost
De Tuin van Jan
I Can Change the World with My Two Hands
Ik Geef om de Jan Eef
Natuur en Milieu Team Zuid
Proeftuin Midwest
Sociaal Tuinieren
Stichting PlantageLAB
Oost Indisch Groen
Vondeldorp



Government

Gemeente Amsterdam
GVB
Waternet
Waterschap Amstel, Gooi and Vecht

NGOs

Amsterdam Smart City
Cirkelstad
De Gezonde Stad
De Groene Grachten
De Waag Society
DGBC greenbuild
Green Business Club Zuidas
Knowledge Mile
One World
Operatie Steenbreek
Pakhuis de Zwijger
Rooftop Revolution
The Green Living Lab
The Things Network
Zo!City



"Rainproof makes our city
resilient to cloudbursts and
at the same time more
attractive, greener and
liveable!"

Municipality of Amsterdam



You can find the latest update of our network
on rainproof.nl/network. Do you make
Amsterdam Rainproof? Join our network.
Mail to info@rainproof.nl

Squares: from grey to green

Three Amsterdam squares and three radically different designs to prevent flooding and make smarter use of stormwater.



Rain(a)way: where art and rain come together

There's an immediately noticeable strip of orange concrete pavers outside the front door of WOW Amsterdam, an arts incubator and hostel located in the Bos en Lommer district. These Rain(a)way pavers, as they are called, were created by designer Fien Dekker and serve more than just an aesthetic purpose: during severe downpours, the pavers help to temporarily slow down the stormwater run-off from adjacent roofs and the square itself, preventing the sewer from overflowing.

Two drain pipes have been disconnected for this purpose and reconnected to the strip of detention pavers. The cavities in the pavers serve to temporarily detain the stormwater, before it is discharged into the sewer. A portion of the stormwater infiltrates into the subsoil through the pervious pavers. The pavers are regularly cleaned with a leaf blower to prevent them from getting blocked.

The Rain(a)Way strip of pavers was funded by a public-private partnership between the WOW hostel, 'city maker' Luca van der Putten, artist Fien Dekker, the West Amsterdam district, Waternet and Amsterdam Rainproof.

The Rain(a)way pavers by Fien Dekker.





A gravel playground collects stormwater run-off in front of De Mirandabad.

“We end up saving a lot of money on the installation and maintenance of the sewer. We need three hundred metres less sewer pipe. So rainproof design doesn't have to be more expensive

Dry feet in front of the swimming pool

The Rivierenbuurt district in South Amsterdam is just like a bathtub: during heavy showers the sewers overflow and all the rainwater flows to the low-lying centre of the area. This makes it all the more important to capture stormwater on the spot where it falls.

Scheduled maintenance work on the front square of the De Mirandabad swimming pool provided a solution for making the square rainproof. Playground equipment was placed in a landscaped depression outside the entrance of the building. Inside this depression is a layer of around thirty centimetres of gravel applied on top of permeable cloth made from geotextile. Excess stormwater from all over the district is collected and attenuated through the playground and the small new bio-retention strips surrounding it.

Even the car park now infiltrates stormwater. The concrete was removed, and infiltration crates were installed underneath the car park containing eight centimetres of porphyry, a type of natural permeable stone. Beneath this is a layer of base material which leaves space between the soil particles (for the experts: the minimum pore volume is forty per cent), so that trees can take root and water is absorbed by the soil. Two rainwater gullies have been added just to be on the safe side, but this turned out to be unnecessary.

Waternet's Danny Jongejeugd is quick to dispel the notion that creating a rainproof square costs a fortune: 'That's not the case at all – in fact, we end up saving a lot of money on the installation and maintenance of the sewer. We need three hundred metres less sewer pipe than in the standard set-up. So rainproof design doesn't have to be more expensive.'



Gravel and wood chips keep the Laterna Magica schoolyard dry.

Waterproof schoolyard to counter erosion

The schoolyard of the Laterna Magica School, a primary school located in IJburg district, features a multi-level design. Since the original design did not yet factor in stormwater flooding, erosion caused parts of the schoolyard to be swept away.

The new design divides the square into three sections: a garden and a playground for the toddlers at the higher level, a lower-lying square featuring a green play area, and an elevated vegetable garden. A trench was added through which the stormwater visibly flows away. This allows children to see how rainwater can be used in a fun and creative way. To prevent erosion, twenty-five fruit trees, fruit bushes, herbaceous plants and flowers were planted which absorb rainwater and keep the soil in place.

The 250 square metres of pavement in the former bike park (making up the central section of the square) were replaced with a green playground boasting willow tunnels and a detention pond. The rainwater is absorbed by the plants.

The Laterna Magica schoolyard is designed by Towards Nature Permaculture Landscape Designs and was funded in part by the Amsterdamse Impuls Schoolpleinen ('Amsterdam Schoolyard Initiative') municipal programme, which was established to make schoolyards more attractive, greener and rainproof. The schoolyards are transformed into vibrant and appealing spaces where children can play freely and learn about nature and the importance of space for rainwater in the city. 🍅

Never too young to learn

Pupils and students from primary school to university set out to experiment with rainwater and learn about the rainproof city in the process.

Since people can't be educated about climate adaptation early enough, Amsterdam Rainproof is collaborating with schools, colleges and universities to provide courses or contribute course materials focusing on climate change and rainwater flooding.

'The raindrop's journey'

The *Natuurlijk, Rainproof* ('Rainproof, Naturally') curriculum teaches secondary school pupils about 'the raindrop's journey': what happens during a torrential downpour? How does stormwater run-off flow, and who is responsible? They also investigate the various rainproof measures in place and explore their own neighbourhoods from a water perspective, using their newfound knowledge to create a plan for preventing pluvial flooding.

The Amsterdam Natuur en Milieu Educatie Centrum ('Amsterdam Environmental Education Centre', ANMEC) developed these course materials for secondary schools together with Rainproof. This curriculum is available free of charge from the ANMEC website for secondary schools throughout the Netherlands.

“Rainproof provides students with a quality learning experience by giving them challenging assignments

Rainproof assignments for students

Students at colleges and universities are assigned to solve specific rainproof dilemmas. The students involved are enrolled not just in engineering and water management programmes but also in other disciplines such as design and media – in fact, this is especially encouraged.

The issues addressed by Amsterdam Rainproof are among the 'major urban issues of our time,' says Maarten Terpstra of the Knowledge Mile. This 'living lab' is located on Amsterdam's Wibautstraat and Weesperstraat, where, in addition to Amsterdam University of Applied Sciences, 200 companies come together to collaborate. The Knowledge Mile has prioritised research into climate adaptation.

In its research, Rainproof explores questions such as how to make residents aware of rainwater flooding and how to involve them in designing a waterproof street or square. Terpstra: 'Rainproof provides the information and is closely involved from start to finish. It's a good learning experience for students, as they are given challenging assignments.'

Joëlle Munster, a student of Communications and Multimedia Design at Amsterdam University of Applied Sciences, focused on the Kohnstammhof for her final-year project. This paved square of the Amstelcity campus, which sits atop of a parking garage, is regularly flooded during heavy rains. Munster painted the square using a paint that lights up when it rains, and developed a game in which players must make the Kohnstammhof rainproof. Players who finish the game within the time allotted can vote for one of the proposed redesigns for the square – all fully rainproof, of course.

HOW

How do you generate public interest in rainwater?

(with 'rainwater beer' for instance)



No rain, no beer.

Website and social media, videos and flyers: effective communication is half the battle. But how do you reach an even wider audience?

As valuable as they are, conferences and meetings about water, climate adaptation or sustainability do not generally reach ordinary Amsterdam residents. This is why Amsterdam Rainproof also uses large-scale campaigns to raise public awareness.

Rainproof launched its own campaign (tagline: 'We are ready for it. What about you?'), but generally prefers to team up with other organisations, as they are able to reach a larger audience, thereby maximising the campaign's impact. →



Rainproof Ride, a bicycle parade with plants and rainwater collection boxes.

“We want to show people the versatility of rainwater – we regard rainwater as the new gold.”

Public events

In late 2015, central Amsterdam's Dam Square was transformed into a 'pop-up park', complete with makeshift grass and tall trees. It was all part of the Rainproof Rave & Ride, a campaign organised in conjunction with the platform OneWorld. The speakers included Dutch celebrity gardener Lodewijk Hoekstra, city alderman Udo Kock and 'water ambassador' Henk Ovink.

A parade of bicycles carrying plants and water containers made its way across the city to Dam Square. Local residents were able to experience how to 'harvest' rainwater themselves. The Rave & Ride event was attended by more than 4,000 people, while the campaign reached more than 3 million people online and was covered by local, national and international media outlets, including an item on the national news.

Another initiative is the rooftop festival Roef, where visitors have the opportunity to get up on the rooftops and learn about their benefits while enjoying musical and theatrical performances and cocktails. The event's message is that, even though the city is becoming increasingly urbanised, only two percent of Amsterdam's flat

rooftops are being used for 'green' purposes. Green-blue rooftops play an important role in climate adaptation.

Roef is an annual festival in which a growing number of buildings in the capital take part. Visitors learn about the many ways in which rainwater can be used and harvested on rooftops: this ranges from cooling buildings to flushing toilets and from preventing flooding to irrigating plants. Instead of having to endure dull lectures, visitors get to enjoy stage plays performed in elevators and other performances while enjoying a cocktail and overlooking the sights of Amsterdam.

'No rain, no beer'

Entrepreneur Joris Hoebe, who created a beer made from rainwater, was featured with his invention in a variety of media outlets, including The Guardian, Channel NewsAsia, Radio538 and De Volkskrant. He and his students in the media lab at Amsterdam University of Applied Sciences (Hogeschool van Amsterdam) were commissioned by Amsterdam Rainproof to find ways to use design in order to involve the public in the process of making the city rainproof.

Hoebe: 'You need a lot of water to make beer, both for production and for refrigeration. I had a flash of inspiration one day when I was making beer and it was lashing rain outside.' Having started out by capturing rainwater in baby bathing tubs, Hoebe went on to develop a professional brewing process, for which he partnered with the Amsterdam-based De Prael brewery.

'In creating Rainbeer, we wanted to demonstrate the versatility of rainwater – we regard rainwater as the new gold. Our label tells the Rainproof story, and our payoff is 'No rain. No beer.' But our most important ambassadors have turned out to be bar personnel. The beer is a good conversation starter, a way for people to discuss a seemingly boring subject in a fun way.' And it works: 'People are taking an interest in rainwater all of a sudden.' Rainbeer has won several innovation and sustainability awards and will soon be launching five new beer varieties across five cities.

Rainbeer takes rainwater and turns it into safe drinking water – something which, Hoebe feels, is still too often thwarted by European legislation. 'We can use beer and rain to break through existing bubbles and get people interested in rainwater in a casual and informal way.'



Rooftop theatre during ROEF festival.


De Regenwacht

A team of three Amsterdam Rainproof partners who go by the name De Regenwacht (the *wegenwacht* is the Dutch roadside assistance service, and *regen* means rain) are helping Amsterdam residents to rainproof their homes and gardens. The members of the team are placemaker Lex de Jong, city creator and engineer Luca van der Putten, and outdoor-space designer Ivo Tanis. They assist Amsterdam Rainproof in areas where the latter lacks time and human resources.

Tanis: 'We want to meet residents and learn what kinds of obstacles they tend to encounter, so we can help them resolve these.' De Regenwacht team uses a hands-on approach to achieve their goal, which involves supporting local residents with their rainproof initiatives on-site and sharing best practices. De Regenwacht addresses problems in residential areas by looking at the root cause. For example, they helped a resident of North Amsterdam rainproof her previously paved garden.

Water label

The Water Label is a certification similar to the Energy Label, except it's designed for rainwater. The label reveals the extent to which a building captures and discharges stormwater. The label makes people aware of the rain resistance of their home or business premises, and encourages them to take rainproof measures. This is valuable, as between fifty and seventy percent of urban land is privately owned, and the Water Label allows building owners to get involved in rainproofing the city.

The Water Label was invented by a group of water professionals who regularly meet. The label was subsequently created by the water consultancy Nelen & Schuurmans at the behest of the local authorities of Amsterdam (through Rainproof), Rotterdam, The Hague and the Water Authority Amstel, Gooi and Vecht. (for more information visit www.waterlabel.net). 

Who is Rainproof?

As an interdisciplinary team with a flexible approach, Rainproof forges connections with the public and private sectors from a semi-independent position.



The strength of the Rainproof team is that the members come from a variety of backgrounds, including urban water management, architecture, political science and consultancy. What they all have in common is a talent for building and maintaining networks, making each team manager somewhat of a community manager.

The fact that the Rainproof team was initially based in a separate location from its clients – the municipality of Amsterdam and Waternet – was essential to their rapid development and enabled them to design the programme from a semi-independent position. It also helped them when involving private partners, as they were their own entity and did not represent any government authority.

In order to be able to liaise closely with their clients and facilitate change within their own organisations, several part-time members have been involved in Rainproof from the start while working for the municipality of Amsterdam and Waternet.

The team fluctuates in size and includes both full-time and part-time members who meet regularly to discuss results and critically evaluate their procedures. The Rainproof approach is a flexible one: the activities and size of the team depend both on the stage of the programme and the needs of the Rainproof network. The Rainproof team has been based at the Waternet offices since 2017, so as to be able to share their experiences with colleagues.

At the former Rainproof office in Pakhuis de Zwijger.

Who's who?

Programme manager **Daniel Goedbloed** is responsible for overall management, represents Rainproof and ensures that all Waternet employees embrace the Rainproof-approach. His self-proclaimed goal is to 'create a city that deals with rainwater in a visible and appealing way that is uplifting and inspiring to everyone. And in which everyone's role is clear in terms of management, design, installation and maintenance.'

Geertje Sonnen worked for Rainproof as a project leader for mainstreaming Rainproof in the municipality until the end of 2017. She was the vital connection to the municipality, promoted Rainproof to all civil servants and got it into municipal policies. **Alex Pixley** assumed this role in 2018.

Geertje Wijten is a policy officer in the Space and Sustainability department of the municipality of Amsterdam and assists her colleagues with various questions and queries. She ensures Rainproof is placed on the agenda for municipal policymaking, local initiatives and European projects.

Lot Locher is a programme strategist who brings structure to the chaos and ensures that the goals are achieved. She also works closely with the private sector, is responsible for Rainproof products, and, using her background as an architect, likes to contribute her own expertise to design.

Irene Poortinga is community manager and central to the rainproof network. She liaises continuously with third parties and is responsible for maintaining the network. Her role also involves maximising Rainproof's exposure among the city's residents.

Torben Tijms is an asset manager at Waternet and has been responsible for coordinating the Rainproof cloudburst plans since last year. He works with engineers, designers and maintenance people to find solutions for extreme precipitation throughout the city.

Paulien Hartog acts as a liaison between the Rainproof programme, Waternet and the national Delta Plan on Spatial Adaptation. She was closely involved in the founding of Rainproof and shares the Rainproof message with national and international audiences.

Kasper Spaan is a planning advisor at Waternet. He and fellow planning advisor **Anna Goede** are responsible for integrating the Waternet philosophy into the policies and procedures of the regional water authority Amstel Gooi and Vecht. He has been involved with the Rainproof programme from the outset and ensures that Rainproof practices are incorporated into urban planning projects.

Finally, Rainproof would not be the organisation it is today without the tireless efforts of the following trainees, helpers and former dedicated core team members and liaisons: **Tjerron Boxem, Jori Hoving, Eljakim Koopman, Caroline Combé, Esther Verheijen, Martine Möllman, Remco van Diepen, Pascal Bos and Jasper Passtoors.**



Paulien Hartog, Kasper Spaan, Lot Locher, Torben Tijms, Maarten Claassen, Daniel Goedbloed, Geertje Sonnen, Martine Möllman, Mirko van Ingen, Anna Goede, Irene Poortinga.

New urban development: a rainproof island

Rainproof is the standard in the urban design plan for the new Centrumeiland IJburg district – both for the government and for residents.

The Centrumeiland district is a brand-new part of Amsterdam, a manmade peninsula located in the IJmeer lake which can accommodate around 1,500 homes. Roughly three-quarters of this number will be built by their future owners.

Rainproof serves as the standard for this new development project, both for public and private spaces. It is therefore also incorporated into the zoning plan for the area and in the requirements for individual plots.

No rainwater sewer system

The sandy soil of the Centrumeiland district makes it easy to infiltrate stormwater, which is then filtered through the subsoil. As clean water subsequently flows directly into the IJmeer, there is no need for the municipality to install a rainwater sewage system on Centrumeiland.

As an alternative, sustainable urban drainage systems are used. Squares, streets and green spaces in the area will be designed with measures to capture, detain and slowly release stormwater run-off. For example, the municipality will construct swales, a type of vegetated ditches that capture excess stormwater and 'slow it down' before it drains through the sewer system.

Detention of excess stormwater is not just important during heavy downpours: since the island is elevated and consists of sand, the soil is at risk of desiccation during extended periods of drought. The captured stormwater serves as a reservoir for these periods.

Residents' responsibilities

People building their own homes on Centrumeiland are responsible for ensuring proper stormwater management. The zoning plan prescribes that plots can process a minimum of 60 millilitres of rainwater per square metre. This can be either aboveground (through blue-green roofs, rain barrels, rainponds or a lowered infiltration field) or underground, using measures such as attenuation crates or rainwater harvesting systems.

By capturing rainwater and temporarily detaining it on rooftops and in raingardens, residents can contribute to making Centrumeiland rainproof. Amsterdam Rainproof acted as a consultant on the zoning plan and, in association with the municipality of Amsterdam, published an 'inspirational leaflet' for people building their own homes.





* coordinate stormwater discharge with the municipality of Amsterdam and Waternet

How to build Rainproof?

- | | | | |
|---|--|----|-----------------------------|
| 1 | Disconnect downpipe from sewer * | 10 | Retention roof |
| 2 | Permeable paving | 11 | Green roofs on garden sheds |
| 3 | Create higher and lower points in garden | 12 | Blue roof |
| 4 | Open gutters | 13 | Rain barrel |
| 5 | Retention pond | 14 | Rainwater harvesting system |
| 6 | Replace pavers with plants | 15 | Speed bump |
| 7 | Strips of gravel | 16 | Green function roof |
| 8 | Attenuation boxes | 17 | Green façade |

Rainproof: a national trend

Amsterdam Rainproof shares its knowledge and experience, and inspires others in setting up programmes with a network-based approach.

Climate-Proof Arnhem

Daphne van der Wal of landscape architecture firm Le Far West and its partner, CASA architectural centre, jointly took the initiative for the 'Climate-Proof Arnhem' project. 'Arnhem has its share of climate-related problems, but everyone shifts the responsibility to the central government. We don't want to use a top-down approach and address people in the kind of moralistic tone sometimes associated with governments. Instead, we want to go bottom-up by hosting coffee sessions devoted to climate change and going out there and knocking on people's doors,' she says.

The municipality of Arnhem, the two water authorities, the Natuurcentrum ('Nature Centre') and the Groen Arnhem ('Green Arnhem') networking organisation have all joined the initiative. The platform's network ranges from residents to local initiatives, businesses and institutions. 'We want to make Arnhem as climate-proof as possible, which means not just rainproof but also heat-resistant and circular.'

Amsterdam Rainproof helped in establishing the Climate-Proof Arnhem project by sharing its expertise and exchanging products. Van der Wal used their model to make a force-field analysis and assessed which parties it needed as collaborators. What are their interests and how can she influence them? Like Rainproof, she drafted a letter of intent, which was signed by the participants.

'But you can't compare Arnhem to Amsterdam,' Van der Wal says. 'Every context is different.' The greatest challenge is to involve not just the trailblazers, but the others as well. 'Our job will be done if we manage to get the majority on board.'





Platform Together Climate Proof

Marcia van der Vlugt first came into contact with Rainproof in her capacity as programme manager for the central government's Spatial Adaptation Incentive Programme. 'One of our goals is to share practical knowledge with as many people and at as many levels as possible, so that others will benefit. When our incentive programme was launched three years ago, we didn't get a lot of feedback and received very few practical questions from people, as the programme was regarded as something initiated by the national government.'

In contrast, Amsterdam Rainproof received plenty of practical questions. 'It was exactly what we wanted. I then instructed Lot Locher, who acted as quartermaster, to collect data on people's needs across the country and develop a solid approach for us.' This analysis, Rainproof's experience and other successful networking strategies have been integrated into the Platform Together Climate-Proof for professionals, which supports local and regional initiatives on a demand-driven basis. This platform is also based on a network approach: collecting and sharing practical knowledge, connecting public and private parties, and simply getting down to business. 'You need to involve everyone who has some measure of control over climate-resilience.'

The Platform: Together Climate-Proof is part of the national Delta Plan on Spatial Adaptation. This new policy plan is designed to promote and actively enforce climate-adaptation measures throughout the Netherlands.

Climate-Proof Delfland

'Our goal is for the region to be climate-proof by 2050. The premise is the same as for Amsterdam Rainproof,' says Tjerron Boxem, climate adaptation community manager at the Delfland Water Authority. He previously worked at Amsterdam Rainproof for three years. His current job description was directly copied from the community manager function at Amsterdam Rainproof.

A project team was established last year with the objective of making the Delfland area climate-proof. 'We cannot handle the challenges facing our Water Authority alone; we need to connect and cooperate with the outside world.' Boxem is therefore assessing potential private and public collaboration partners for Delfland, what their contribution might be, and what kind of knowledge, connections or financial support they might require.

Boxem: 'I agree that sounds similar to Rainproof, but we're dealing with a different group of stakeholders here. Delfland serves an entire region with several cities, along with rural areas and lots of greenhouse construction. To them, the distance to the Water Authority is huge. When possible we tend to join existing initiatives, so as to bridge the gap.' Each area requires its own specific approach.



Rainproof: what do others think?

‘Rainproof is creating the “quadruple helix” by acting at a local level while simultaneously taking advantage of innovations created by the public and private sectors and leading research institutions, backed by the support of local communities. Rainproof is an initiative by and for Amsterdam and its residents.’



Arjan van Timmeren
Amsterdam Institute
for Advanced
Metropolitan Solutions
(AMS)

‘Climate adaptation was added to our urban agenda as a result of the “Rotterdam Climate Proof” programme. As with Rainproof, effective communication is an important part of that programme. We need to partner with residents and start investing in small-scale measures together.’



Arnoud Molenaar
Chief Resilience
Officer Rotterdam

‘Making Amsterdam climate-proof is an immensely complex challenge that will keep us busy for decades. Rainproof has come up with a very effective blueprint for collaboration, which involves informing people about the actual risks while at the same time providing attractive solutions.’



Bart Stoffels
Climate Adaptation
City Deal Coordinator

‘Many garden owners think keeping a sustainable garden is very time-consuming. But paved gardens should really be a thing of the past, given all the damage caused by heavy rain and heat. I applaud Amsterdam Rainproof’s strong commitment to making gardens more sustainable.’



Egbert Roozen
Association of
Gardeners and
Landscapers (‘VHG’)

‘Amsterdam Rainproof has made an international impact with its chain-based approach. Our sustainable treatment of water – both qualitatively and quantitatively – serves as an example for many cities around the world.’



Carolien Gehrels
Arcadis,
Design &
Consultancy for
natural and built
assets

‘Rainproof is applying the “Amsterdam Approach” to make the city climate-proof: businesses, research and educational institutions, local authorities, NGOs and, above all, the public are all taking their responsibility and coming up with innovative solutions. Pakhuis de Zwijger contributes by serving as a platform for inspiration and acceleration.’



Egbert Fransen
Pakhuis de Zwijger
Amsterdam centre
for debate

‘Amsterdam Rainproof is a source of inspiration.’



Fred Prins
GEP Rainwater,
specialised
in rainwater
systems

‘Amsterdam Rainproof manages to take large-scale and positive action to prevent flooding. The commitment of the homebuilders, landscapers, residents and others involved in their projects is a testament to their success.’



Bert Palsma
Foundation for Applied
Water Research
(‘STOWA’)

‘Amsterdam Rainproof has raised public awareness of the large amount of stone and concrete in the city and is mobilising residents to make their homes and streets rainproof. Architects are in a position to make the city “softer”, and we need to use their solutions to improve the quality of life in the city.’



Fred Schoorl
Association of Dutch
Architectural Firms
(‘BNA’)

‘With all the data we have collected on the city, we have the resources needed to make it future-proof. As part of the Amsterdam Rainproof approach, all residents are given the opportunity to help keep people’s feet dry. Now that’s what I would call innovation.’



Ger Baron
Chief Technology Officer
Amsterdam

‘Amsterdam Rainproof is all about raising awareness and taking action: how does climate change affect you, me, and the city? Rainproof represents a sustainable city where the Paris Agreement is not an abstraction but a reality: on the pavements, in your front yard, on the street, in the parks and in the canals.’



Henk Ovink
‘Water Ambassador’
for the Dutch government

‘With typical Amsterdam moxie, Rainproof is tackling the severe downpours caused by climate change. They manage to achieve tangible results by sharing a clear, effective message and listening to people.’



Hugo Gastkemper
Stichting RIONED –
branche organisation
of urban water
management

‘With its local expertise, Rainproof was a valuable partner in our study into the climate-proof city and in preparing for extreme precipitation. I really admired the efficiency with which they shared their knowledge and their strong public relations.’



Jeroen Kluck
Amsterdam
University of
Applied Sciences

‘Rainproof is a great example of how governmental organisations, knowledge institutes, citizens and businesses work together on solutions. Berliner Wasserbetriebe is exploring ways to increase the impact of such examples for the city of Berlin.’



Jörg Simon
Berliner
Wasserbetriebe
(Berlin water
company)

‘Rainproof has inspired me in discussions about statistics and technology to return to the same question: How can we work together with residents to protect our environment from increasingly extreme rainfall.’



Lambert Verheijen
Dike Reeve
for the Maas and
Waal area

‘The Rainproof approach gives people access to expertise and fosters enthusiasm and commitment. The network-based approach has been a wonderful source of inspiration for our city in terms of working directly with residents to increase the appeal of public space.’



Paul de Beer
Alderman for Finance,
Sustainability and
Sport for the City of
Breda

‘There is massive potential in rooftops. De Groene Grachten and Rooftop Revolution have partnered with Amsterdam Rainproof to create solutions that meet today’s needs, including the installation of 25,000 square metres of water-detention roofs in the Zuidas business district.’



Suze Gehem
De Groene Grachten,
making Amsterdam’s
canal houses
sustainable

‘One of the challenges of the Delta programme is how to better equip our country to handle weather extremes. Amsterdam Rainproof is working with residents and businesses to make the city rainproof, and serves as an inspiration to other cities and towns.’



Wim Kuijken
Delta Commissioner
for the Dutch
government

‘Water management in the Low Countries is a collective challenge, and that collective is us, the public at large. So we should all get those pavers out of the garden and make them green, install a green roof, and start harvesting rainwater to flush the toilet.’



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Colophon

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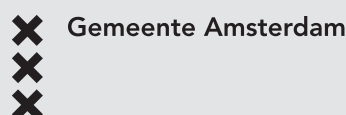
Do you want to start rainproofing your area? Do you have a question for the Rainproof-team or do you want to get in touch with someone from the Rainproof-network? Then check www.rainproof.nl or contact us via info@rainproof.nl, Twitter @Rainproof020 or Facebook: Amsterdam Rainproof.

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waternet
waterschap amstel gooi en vecht
gemeente amsterdam



Amsterdam
Rainproof

every drop counts



every drop counts